MECHANICAL ENGINEERING

March, 1958

Progress in Railway Mechanical Engineering—1956-1957

Design Considerations for AWHEM 15,000-Psi Flanges

Experimental Development Work With 15,000-Psi Wellhead Connections

Control of 15,000-Psi Well Pressures

The Job of the Specialist in Management

Designing Belts for Material Handling

Gas Turbines for Process Applications

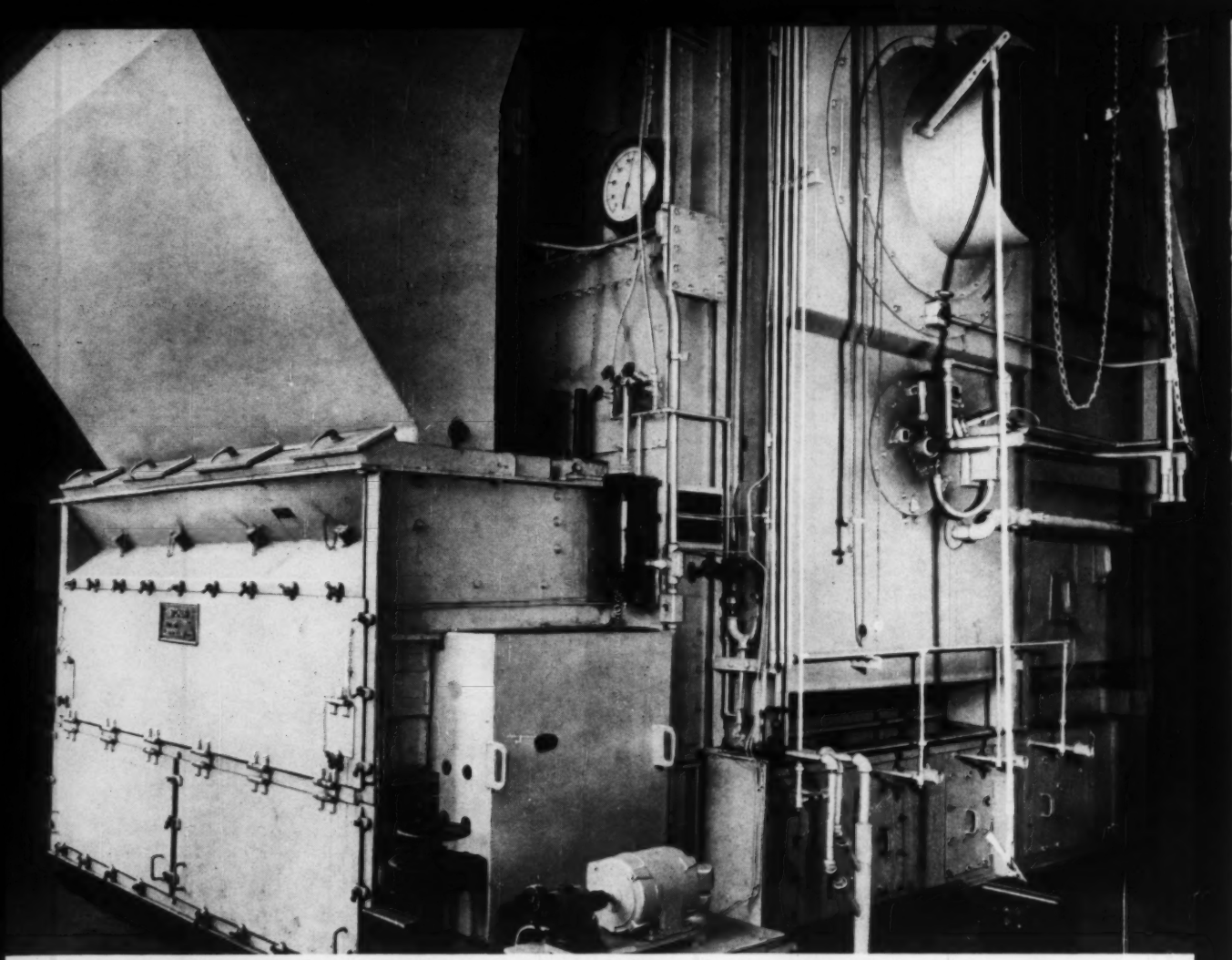
How to Understand an Annual Report

The Safe Use of Isotopes in Industry

Shippingport—Preliminary Testing

Complete Contents on Pages 3 and 5

Digital Process Control



B&W Integral-Furnace Boiler at Case Institute of Technology, Cleveland, Ohio, has a capacity of 24,000 lb of steam per hr at operating pressure of 225 psi and design pressure of 250 psi. Consulting Engineer: McGeorge-Hargett & Associates, Cleveland. Illustration above shows a view of the stoker in the front wall and gas burner in side wall.

B&W INTEGRAL-FURNACE BOILER PROVES VERSATILITY AT CASE INSTITUTE

Specially Designed Firing System Provides Two Steam Output Ranges

Faced with the problem of heavy steam loads in winter and greatly reduced loads in summer, Case Institute of Technology, Cleveland, Ohio, installed a B&W Integral-Furnace Boiler with a dual firing system.

To answer heavy load requirements during the winter heating season, the boiler is fired by a B&W Jet-Ignition Stoker. Operating as a coal-burning unit, it economically supplies steam for heating, laboratories, and other uses at 6,000 to 24,000 lb of steam per hr. During the light load summer months, boiler-firing switches to a natural gas unit built into the furnace wall. This forced draft burner is fitted with automatic combustion controls for a lower steaming range of 2,000 to 10,000 lb of steam per hr.

Flexibility of operation in this B&W installation is a highly economical answer to the "peak and valley" seasonal demand faced by Case. The two firing arrangements operate completely independent of each other.

Efficient, trouble-free performance is another reason why B&W Integral-Furnace Boilers are consistently selected by institutions and for commercial and industrial installations throughout the country. Completely integrated units, B&W Boilers are backed by the undivided responsibility of one manufacturer with nearly a century of steam generating experience, and a national network of plants and field engineers. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

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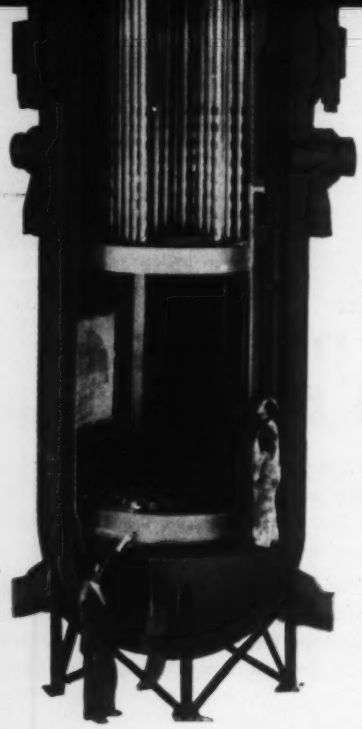

Full-scale cutaway model of 4-story high Shippingport reactor. The reactor vessel, indicated by the colored areas, was designed and built by Combustion. Model made for Westinghouse by Gardner Displays.

Today, commercial electric power from the atom is a reality in America. On December 2, 1957, the country's first full-scale atomic power plant... the Shippingport Station operated by the Duquesne Light Company... went critical. It began producing power December 18 and reached full power output 5 days later. Designed by Westinghouse Electric Corporation for the Atomic Energy Commission, this pioneer nuclear power plant is now in regular operation, supplying electricity to the Pittsburgh area.

Combustion Engineering was one of Shippingport's major suppliers. Its contribution: the heaviest unit of atomic power equipment ever built... the 235-ton reactor vessel—depicted by the colored areas in the picture opposite. This mammoth container houses the nuclear fuel charge within 8½-inch steel walls. More than 3½ tons of water pass through the vessel every second—at pressures of about 2,000 pounds per square inch—to carry off the tremendous heat generated by the nuclear reaction. Though it stands over three stories high, many of its massive parts were machined to watchmakers' tolerances. Entirely new fabrication and inspection techniques had to be developed to make such precision possible.

Combustion's activity in the field of nuclear power has ranged from such civilian projects as Shippingport and the Fast Breeder Reactor vessel for the Enrico Fermi Plant* to the design and manufacture of a complete submarine reactor system and numerous components for our nuclear Navy. C-E's highly specialized personnel and extensive facilities for nuclear work will enable the Company to occupy as important a place in the future use of atomic fuels as it has long held in the field of conventional power generation.

*Designed by Atomic Power Development Associates, Inc. for operation by Power Reactor Development Company

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MECHANICAL ENGINEERING

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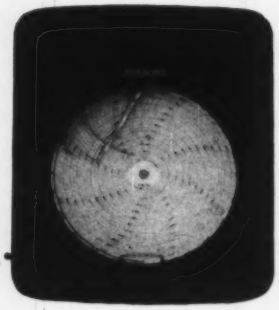

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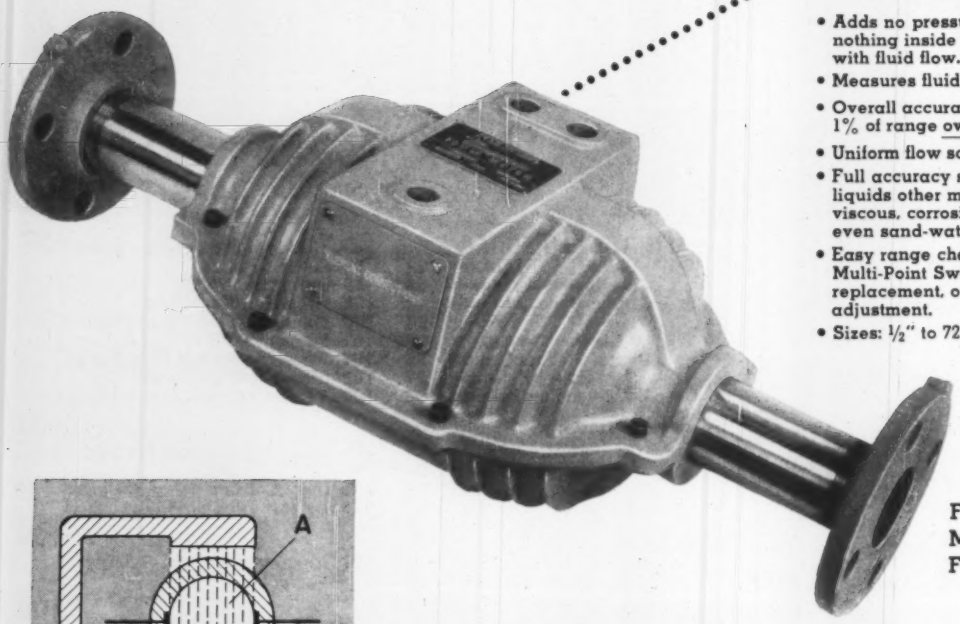

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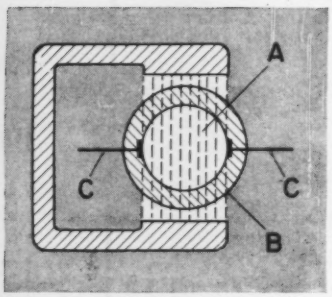

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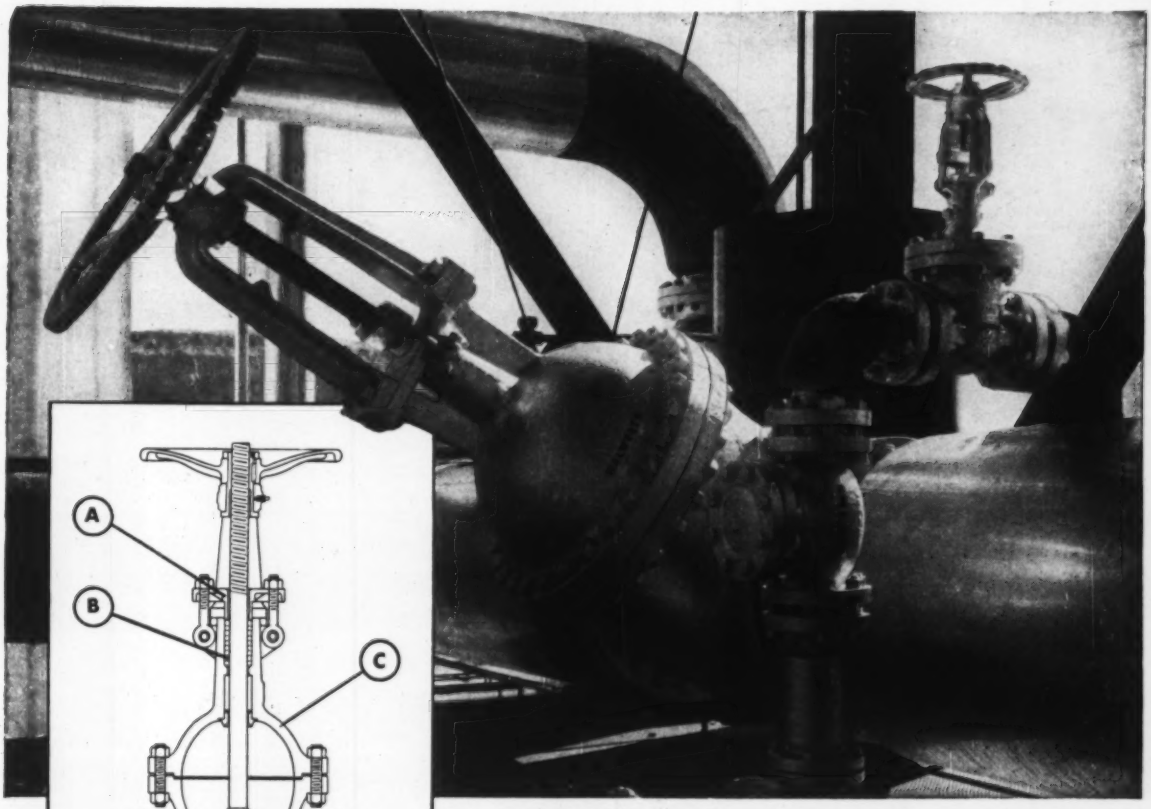

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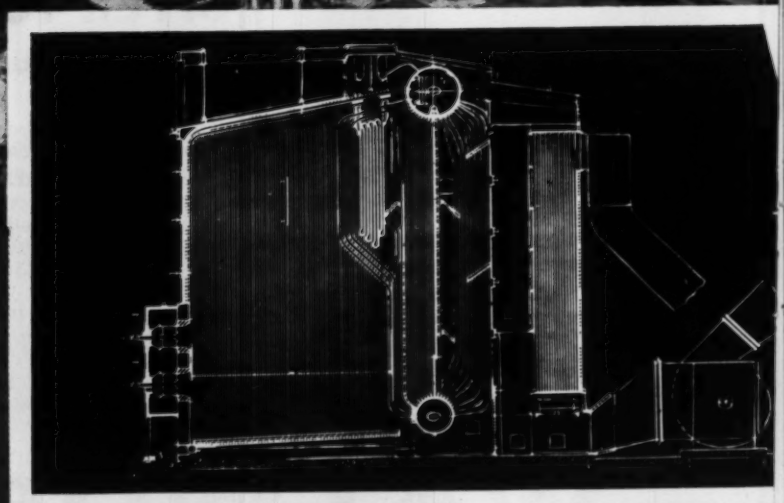

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. . . . . 440,000 lbs./hr.

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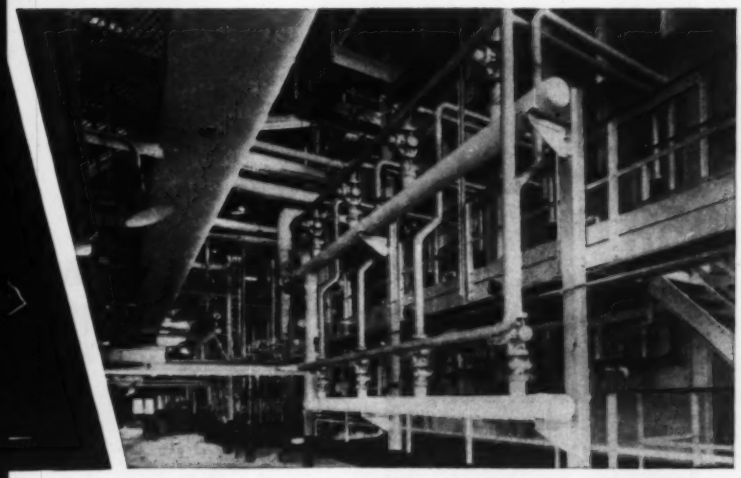

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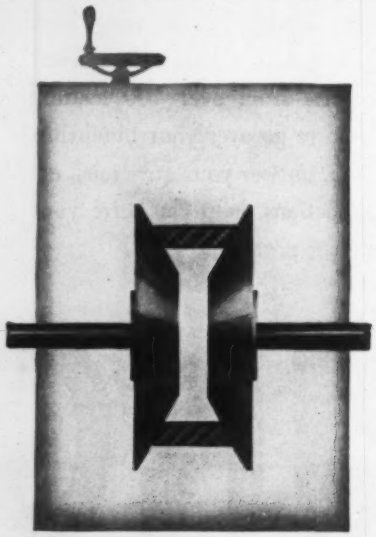

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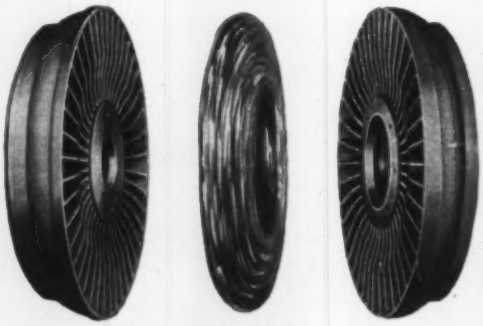

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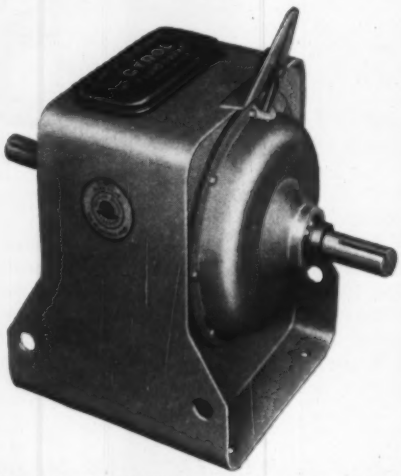

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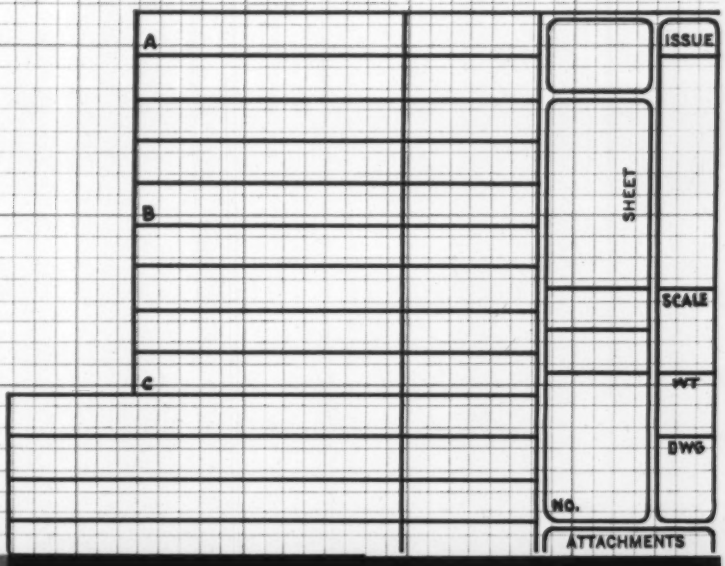

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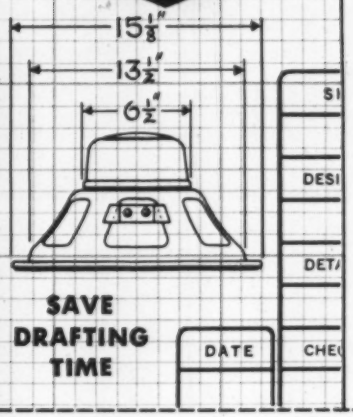

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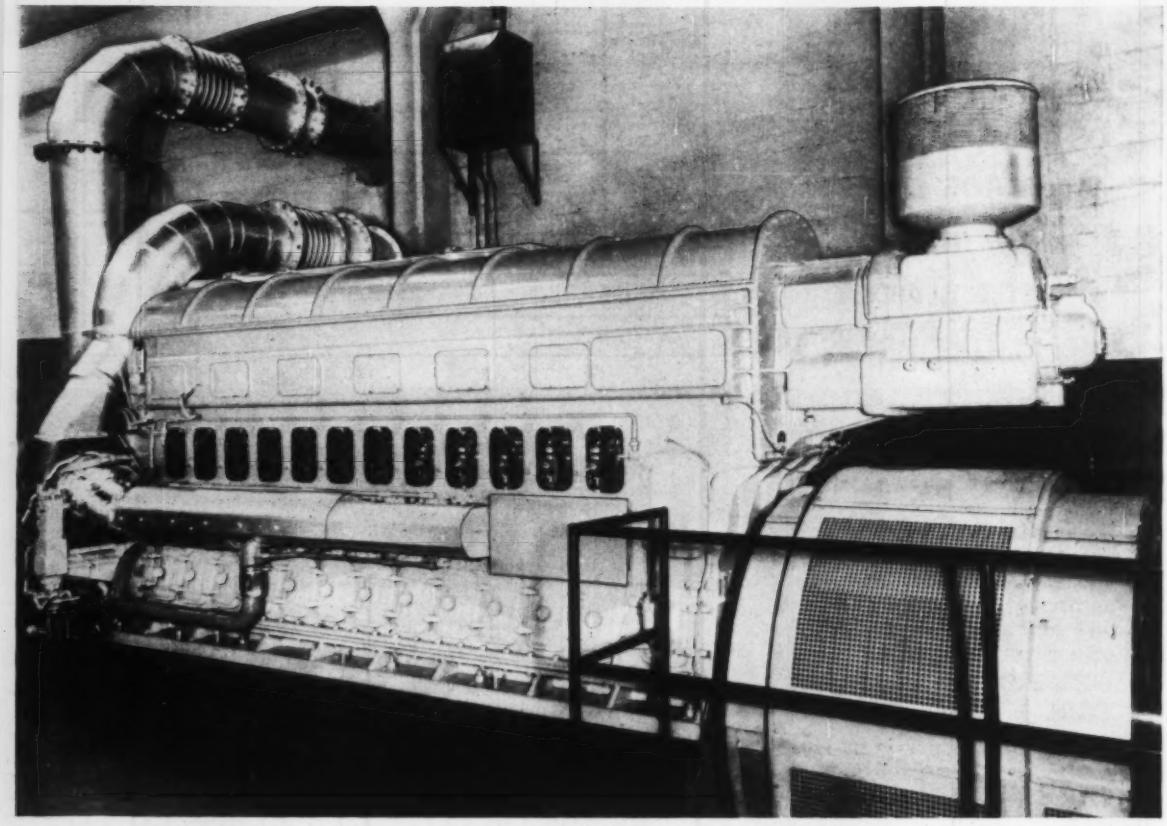
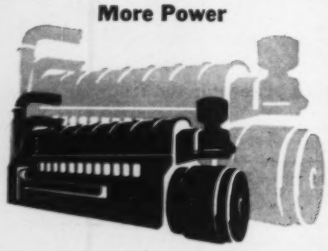
NOW Fairbanks-Morse
TURBOCHARGED



Now from Fairbanks-Morse comes the year's most significant power news: the Opposed-Piston diesel is turbo-supercharged!

Backed by 20,000 hours of actual operation and research, this new, yet proved, design increases O-P horsepower by 50%. At 900 rpm., for example, the turbocharged O-P is conservatively rated at 300 hp. per cylinder. Combining simple, two-cycle Opposed-Piston design of engine with new Fairbanks-Morse-designed system of turbocharging produces compact, reliable power with low operating and maintenance costs. None of the basic O-P advantages have been eliminated. In fact, many parts are interchangeable between turbocharged and non-turbocharged Opposed-Piston engine models.

More Power



The un-turbocharged O-P is the industry's leader in compact power . . . now 50% more power can be placed in the same installation with the same size turbocharged O-P.

Lower Weight

—per horsepower. Increased O-P power is more widely applicable where weight and foundation costs are restrictive. Weight per horsepower has been reduced by 27%.

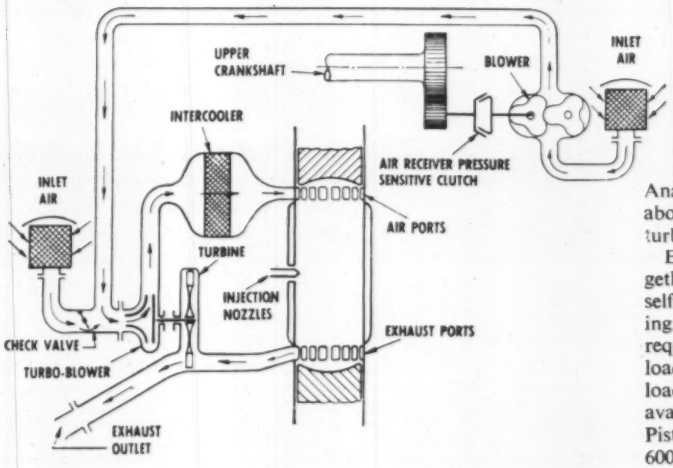
Increased Thermal Efficiency

The new, performance-proved thermal efficiency of the turbocharged Fairbanks-Morse Model 38TD-8⅛ O-P diesel is knocking on the door of a new high of 40% efficiency.

OPPOSED-PISTON DIESEL

50% MORE POWER

for Marine and Stationary Applications



Matched Engine and Turbocharging

Analysis of many turbocharging options established the above arrangement for optimum performance of the turbocharged Opposed-Piston diesel.

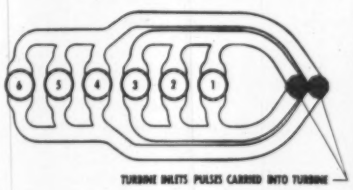
Exact matching of O-P engine and this system, together with manifold design, results in an engine that is self-sustaining over the entire load range, including starting. The small engine-driven auxiliary blower meets the requirements of sudden, large load changes at fractional loads only—and is automatically declutched above ⅓ load. Power formerly used for blower drive is therefore available at the flywheel of the turbocharged Opposed-Piston Diesel. Fairbanks, Morse & Co., Dept. ME-3, 600 S. Michigan Ave., Chicago 5, Ill.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

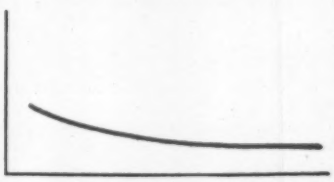
DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • RAIL CARS • ELECTRICAL MACHINERY • PUMPS • SCALES • HOME WATER SERVICE EQUIPMENT • MAGNETOS

Pulse System



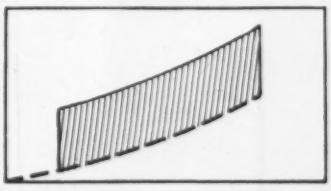
F-M exhaust manifolding carries peak pulse energy directly to the turbine drive, thus taking full advantage of additional driving force available in these exhaust pulses.

Lower Fuel Consumption

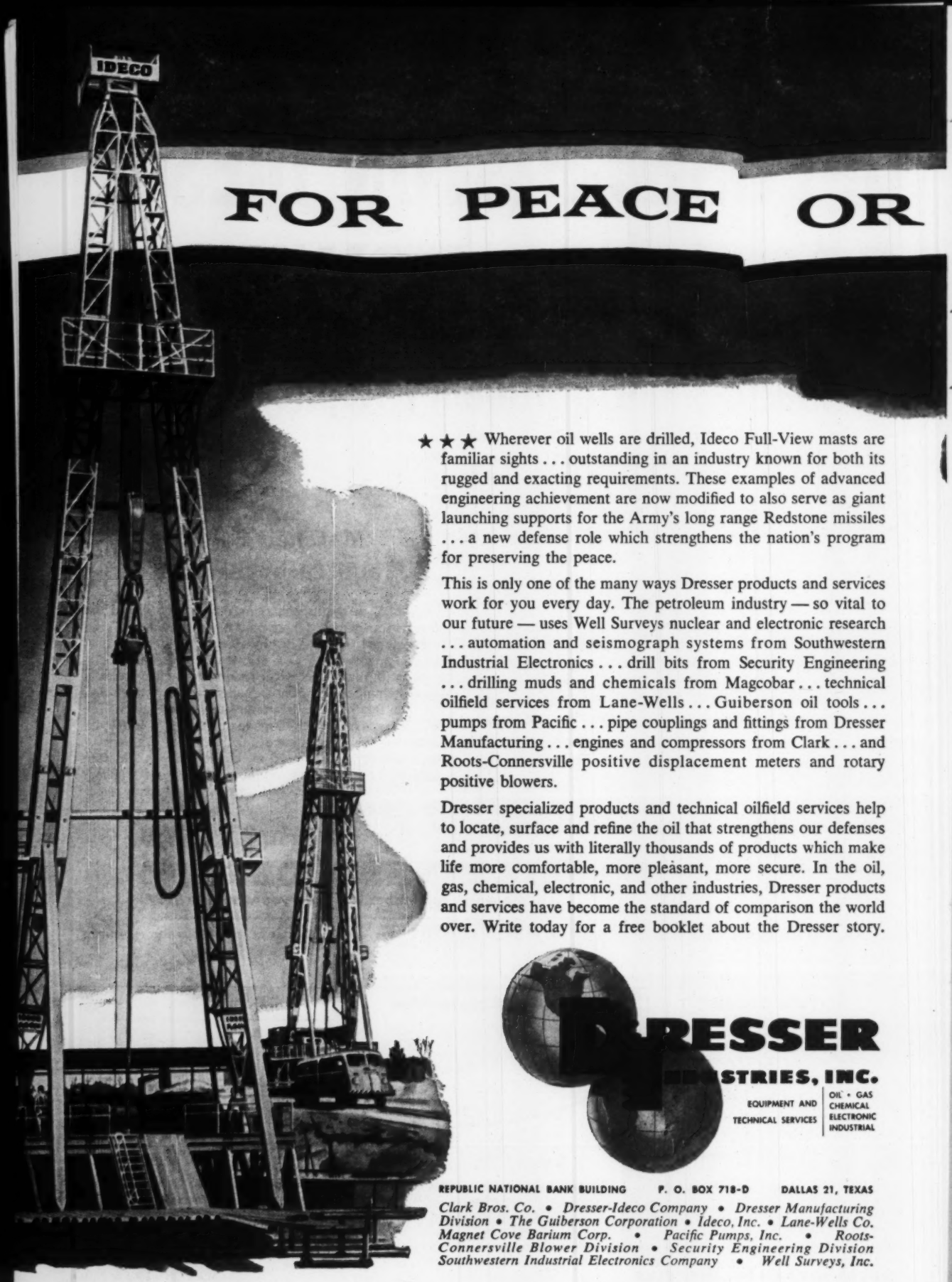


For full-load operations, specific fuel consumption of the turbocharged O-P is 5% to 10% lower than un-turbocharged O-P—and very much lower for part loads.

Bonus Power



At loads above approximately ⅓ rating, the auxiliary blower is automatically declutched, thus making additional, usable power available at the flywheel.



FOR PEACE OR

★ ★ ★ Wherever oil wells are drilled, Ideco Full-View masts are familiar sights . . . outstanding in an industry known for both its rugged and exacting requirements. These examples of advanced engineering achievement are now modified to also serve as giant launching supports for the Army's long range Redstone missiles . . . a new defense role which strengthens the nation's program for preserving the peace.

This is only one of the many ways Dresser products and services work for you every day. The petroleum industry — so vital to our future — uses Well Surveys nuclear and electronic research . . . automation and seismograph systems from Southwestern Industrial Electronics . . . drill bits from Security Engineering . . . drilling muds and chemicals from Magcobar . . . technical oilfield services from Lane-Wells . . . Guiberson oil tools . . . pumps from Pacific . . . pipe couplings and fittings from Dresser Manufacturing . . . engines and compressors from Clark . . . and Roots-Connersville positive displacement meters and rotary positive blowers.

Dresser specialized products and technical oilfield services help to locate, surface and refine the oil that strengthens our defenses and provides us with literally thousands of products which make life more comfortable, more pleasant, more secure. In the oil, gas, chemical, electronic, and other industries, Dresser products and services have become the standard of comparison the world over. Write today for a free booklet about the Dresser story.

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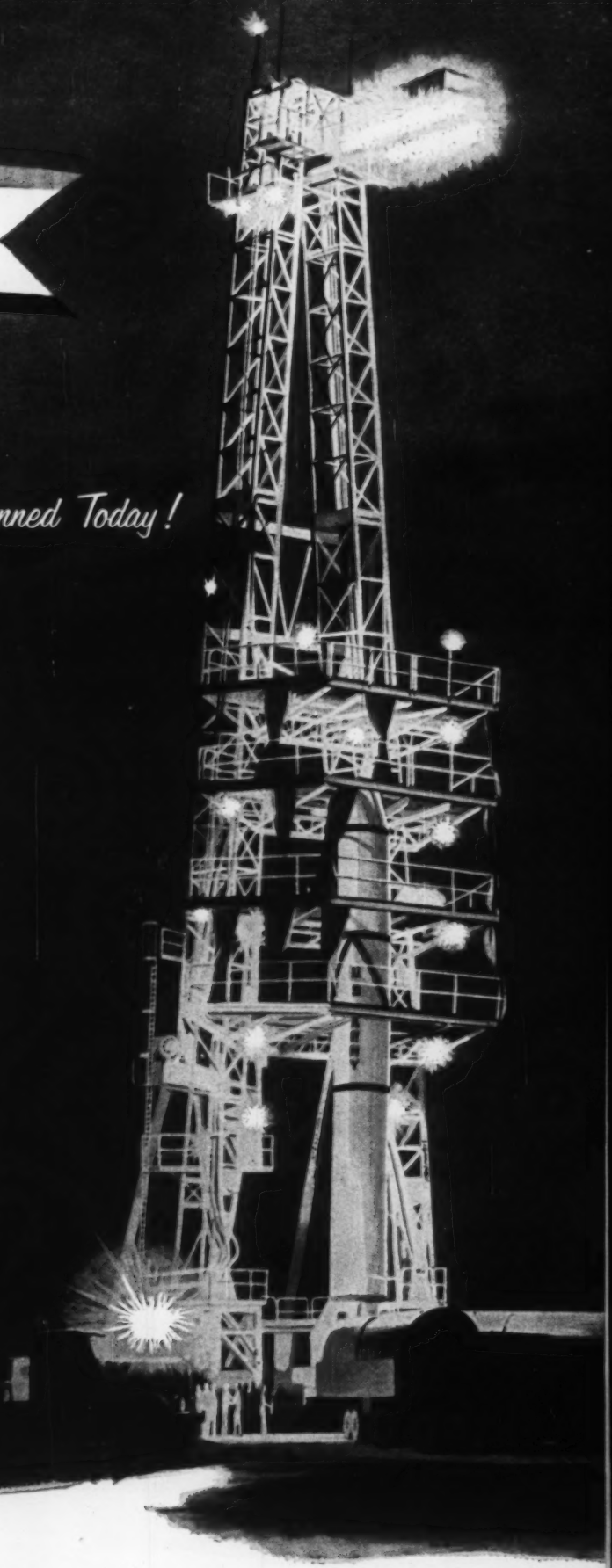
DEFENSE

Tomorrow's Progress Planned Today!

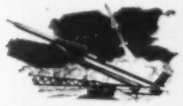


OTHER IMPORTANT DEFENSE APPLICATIONS OF DRESSER PRODUCTS AND EQUIPMENT

Dresser Manufacturing Div. supplies flashwelded connecting rings for powerful jet engines used in military aircraft. Some types of aircraft engines require as many as 85 Dresser rings.

Roots-Connersville makes compressors and blowers for atomic submarines; gas pumps for atomic energy installations; blowers for "lifting bag" inflation to raise crashed aircraft.

Clark Turbo-Mobile power plants, rail-mounted, supply emergency electricity for Navy Yards, docks, hospitals, and major disaster areas. Unit has capacity of 6750 kilowatts, enough power for a city of 12,000.



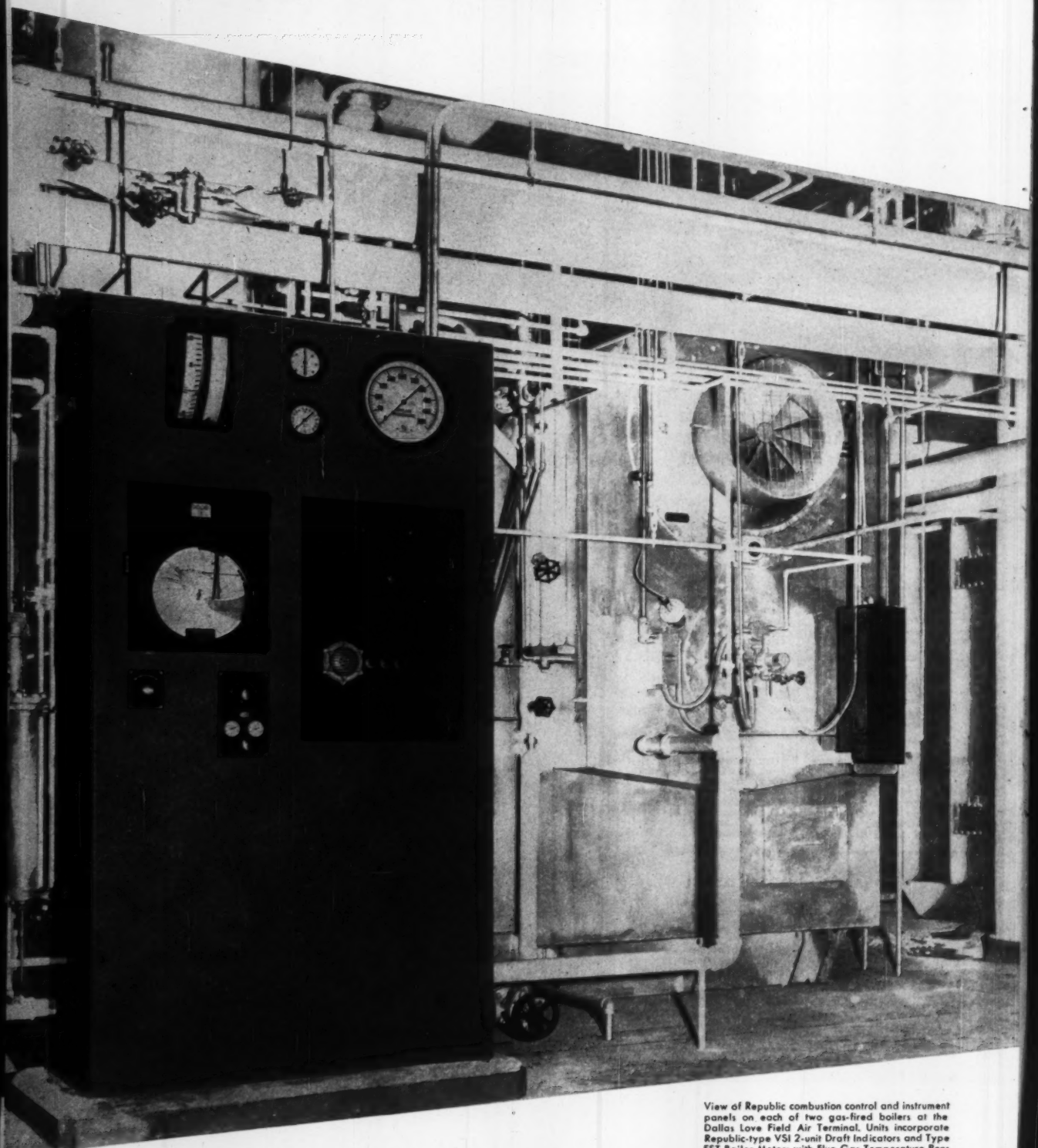
High pressure compressors from Clark . . . instrumentation and other electronic equipment from Southwestern Industrial Electronics . . . are used in guided missiles and many other important military applications.

Dresser-Ideco supplies structural equipment used in military defenses, including radar outposts for our remote Arctic warning system as well as microwave, radio and television towers.

Pacific provides the Navy with Turbo pumps for ships' main and boiler feed pumps. Equipment from other Dresser companies is also used on both merchant ships and naval vessels.

ANOTHER REPUBLIC ACHIEVEMENT!

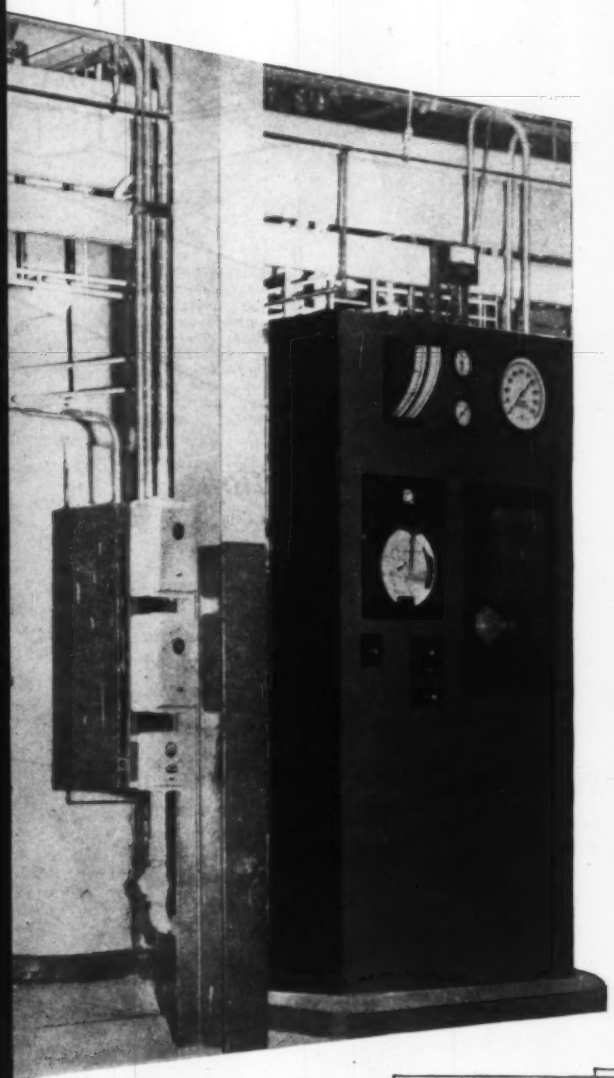
Republic Controls on Package



View of Republic combustion control and instrument panels on each of two gas-fired boilers at the Dallas Love Field Air Terminal. Units incorporate Republic-type VSI 2-unit Draft Indicators and Type EST Boiler Meters with Flue Gas Temperature Pens

Boilers Regulate "Indoor Weather"

...at Dallas' new Love Field Air Terminal



Complete Republic combustion control includes such features as on/off and modulating operation, instrumentation and flame failure control. This type of system operates two 15,000 lbs/hr package boilers, which supply 235 psi steam to centrifugal refrigeration compressors for the Terminal's air conditioning.

Republic's modern control designs are right at home in this $8,000,000 air terminal, which also features such innovations as touch control automatic doors, two-way moving sidewalks and carefully regulated "indoor weather". The new Love Field Air Terminal is truly one of the most modern in America.

Advanced-design combustion controls, based on Republic's experience in plants of all sizes—from package boiler installations to large central station units—are your best guarantee of premium performance from your major equipment. A Republic engineer is ready to help with your instrument and control planning. Republic sales offices are located in principal cities throughout the U.S. and Canada.

REPUBLIC
FLOW METERS CO.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

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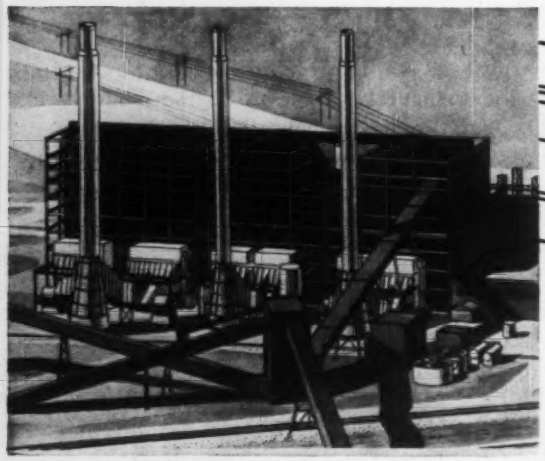
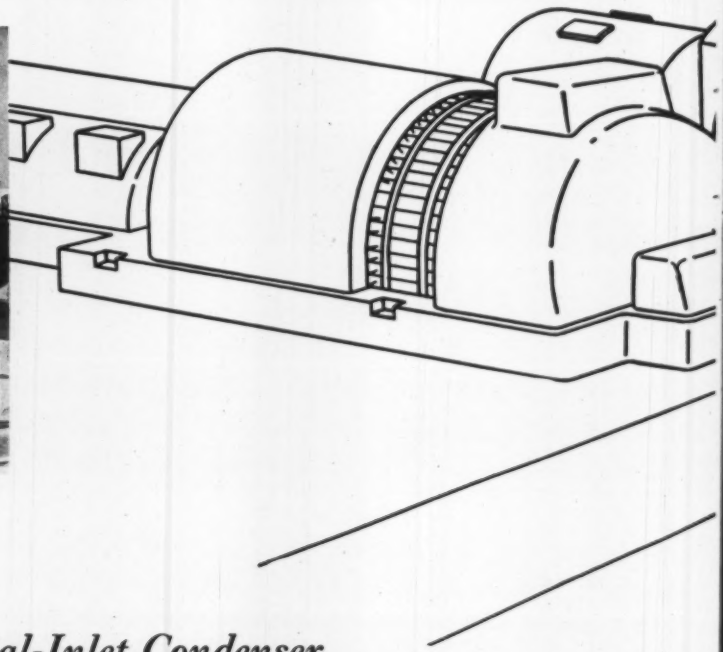
DALLAS LOVE FIELD AIR TERMINAL

Associated Architects: Broad & Nelson; Jack Corgan, Dallas
Engineers: Forrest & Cotton, Dallas
Combustion Controls & Instruments: Republic Flow Meters Co., Chicago

another forward step in

CONDENSER PROGRESS





New 130,000 sq ft Axial-Inlet Condenser for Unit No. 3 at Union Electric's Meramec Station will serve 280,000 kw Axial-Exhaust Turbine

HERE'S another outstanding example of the superior adaptability of Ingersoll-Rand condenser design. As shown by the artist's rendering at the right, the new 130,000 sq ft I-R surface condenser for Union Electric's No. 3 Unit at Meramec Station will connect directly to the discharge end of the 280,000-kw axial-exhaust turbine. A precisely engineered flow passage from turbine to condenser tube bundle assures maximum overall turbine-condenser performance.

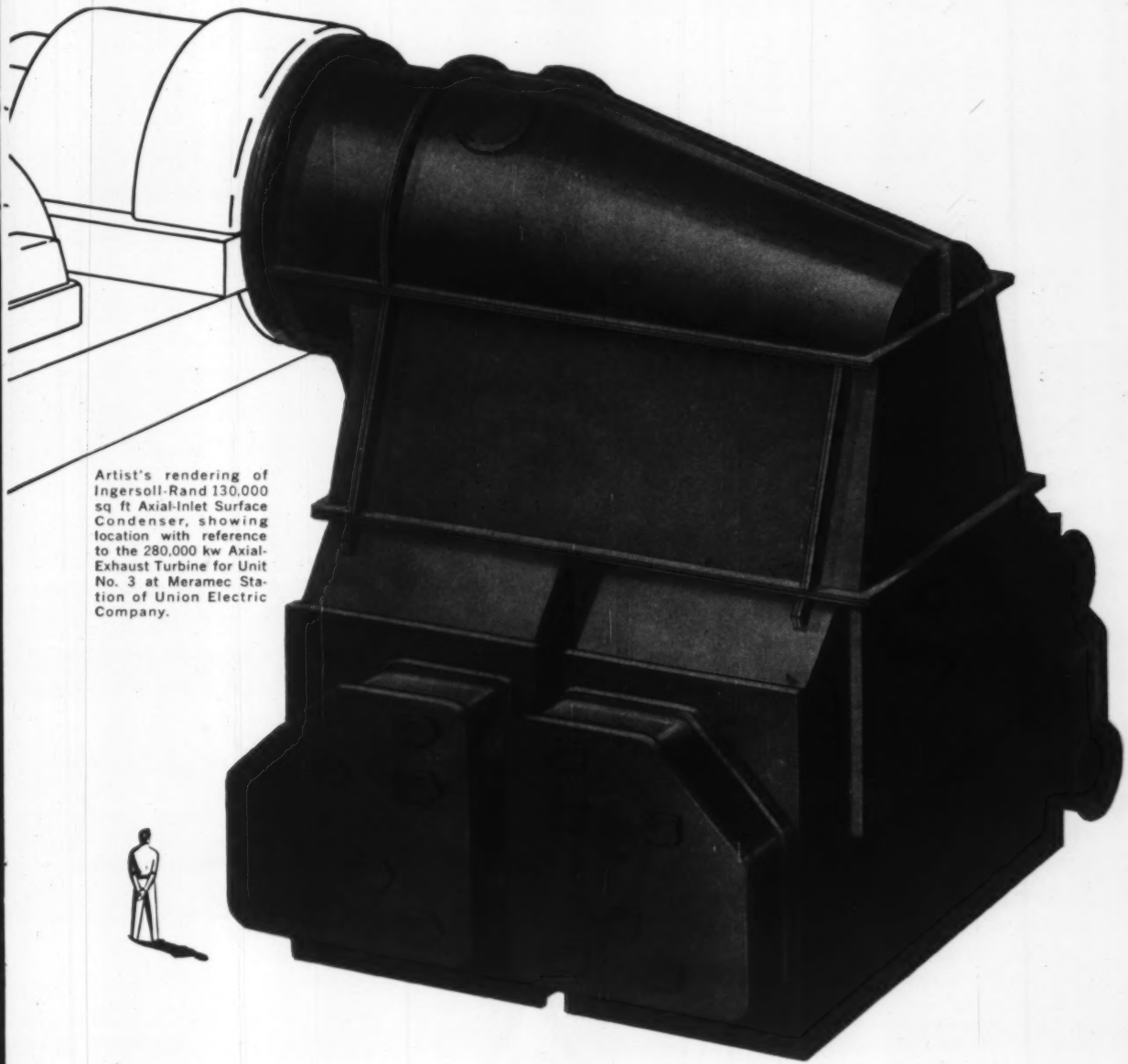
This new type of Axial-Inlet design marks an important advance in condenser technology—the result of close cooperation between I-R engineers and the turbine designers. The condenser unit is of the two-pass, rectangular type with divided water boxes and power-driven reversing valves.

This 130,000 sq ft condenser will be the *third* I-R unit at Meramec Station, Units 1 and 2 being served by two 90,000 sq ft Ingersoll-Rand condensers of conventional under-turbine design.

Whatever your surface condenser requirements, they can be met to excellent advantage with the versatile Ingersoll-Rand rectangular design. Your I-R engineer will be glad to consult with you on the design of equipment best suited to your needs.

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS

by Ingersoll-Rand



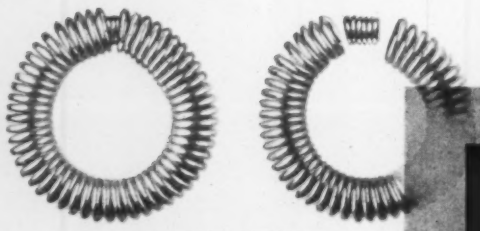
Artist's rendering of Ingersoll-Rand 130,000 sq ft Axial-Inlet Surface Condenser, showing location with reference to the 280,000 kw Axial-Exhaust Turbine for Unit No. 3 at Meramec Station of Union Electric Company.

Ingersoll-Rand

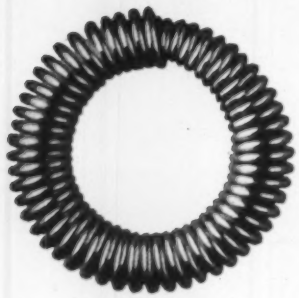
11 BROADWAY, NEW YORK 4, N. Y.

CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES 4-462

How a change in spring design can reduce cost and improve performance.



FIRST DESIGN



IMPROVED DESIGN

In the original conception of this switch retaining spring, an extension spring was formed into a garter spring by inserting a small plug in the form of a spring into the two ends. Assembly operation proved difficult and costly.

In the redesigned spring, one end is reduced in diameter and inserted into other end, eliminating the spring plug and providing stronger unit.

Early consultation with our spring specialists, following the determination of fundamental performance characteristics, is often insurance against unnecessarily complicated manufacture. Write for pamphlet "How to solve your spring problems." Gives case histories and valuable design considerations for various types of springs.

Associated Spring Corporation

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Compact in design, Streamliner 200 stands just 22″ high . . . 38″ deep, with feedboard. Prints stack automatically. Controls are simple, easy to operate. Stand, shown above, is optional.

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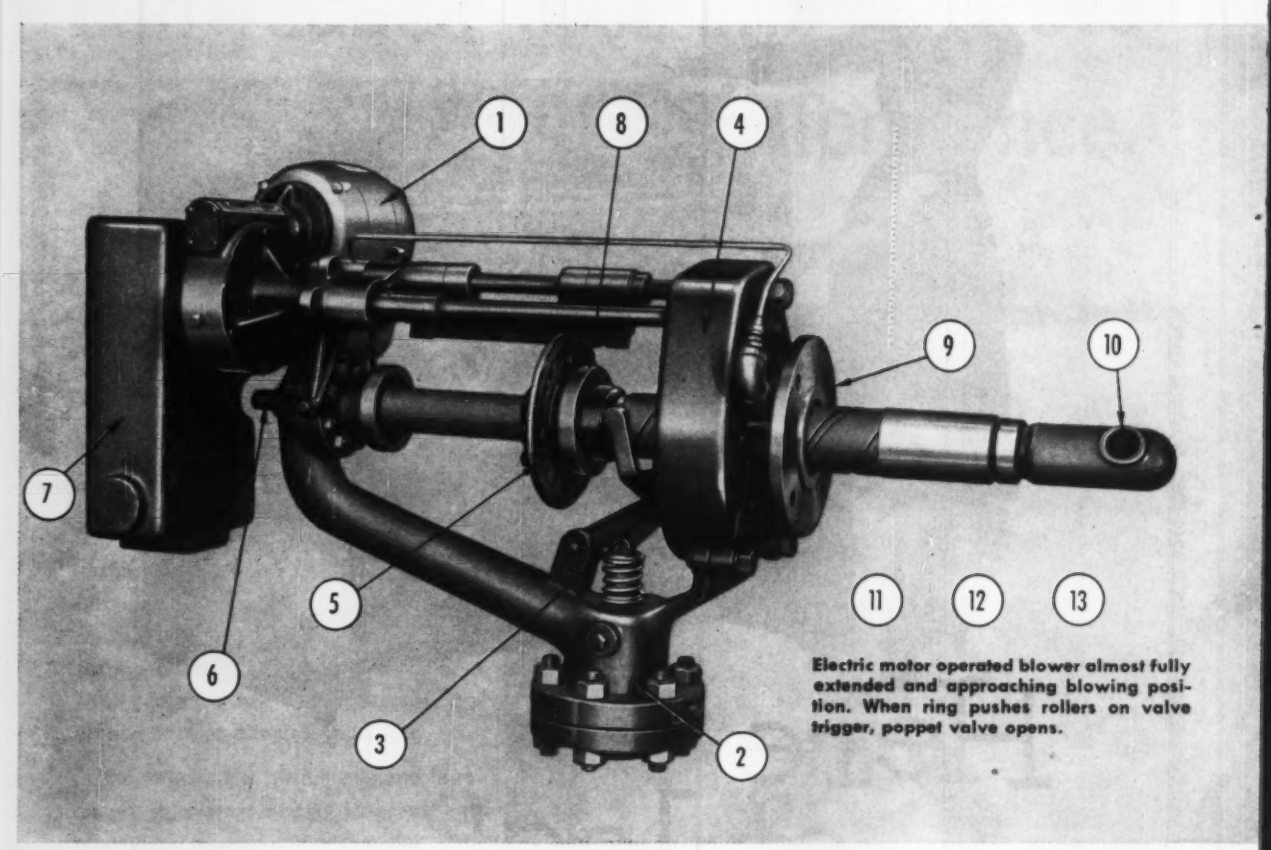

Electric motor operated blower almost fully extended and approaching blowing position. When ring pushes rollers on valve trigger, poppet valve opens.

(1) Single motor (electric or air) both rotates and propels the nozzle

(2) New high-flow poppet type valve assures tight seating without critical adjustment, has welded-in seat with stellited surfaces available.

(3) Positive mechanical action of valve without pilot or diaphragm actuation

(4) Positive mechanical drive through gears for all operations

(5) Valve can open only when nozzle is in blowing position

(6) Adjustable control for individual unit blowing pressure . . . no orifice required in line

(7) Simple, reliable control for local or remote push button operation . . . easily adapted to automatic sequential operation (either air or electric)

(8) Blowing arc easily adjusted for position and extent (up to and including 360°)

(9) Simple mounting on all types of wall construction. No other external support needed. Can mount in any position permitting piping drainage

(10) Improved blower nozzle provides more *available* cleaning energy per pound of steam or compressed air

(11) Completely automatic from start to finish

(12) Suitable for outdoor use without protection except under very severe ice conditions

(13) All operating parts readily accessible for easy maintenance

at LOWER COST

IMPROVED

MODEL IR BLOWERS

(SHORT RETRACTING LANCE TYPE)

This improved Diamond Model IR Blower does a better job of cleaning water cooled furnace walls, hopper slopes or narrow portions of tube banks adjacent to walls. The retracting feature enables it to operate in zones of extremely high gas temperature; it will remove all dust and most slag deposits over a wide radius from the nozzle.

Cleaning furnace wall tubes effectively reduces gas temperatures leaving the furnace . . . improves overall efficiency of tube bank cleaning. Also, furnace wall cleaning contributes substantially to control of superheat and reheat steam temperatures on high-duty units.

Check the features listed on the left-hand page. For additional information on the improved Model IR, ask your local Diamond office or write directly to Lancaster for a copy of Bulletin 1079AA.

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

Diamond Specialty Limited, Windsor, Ontario

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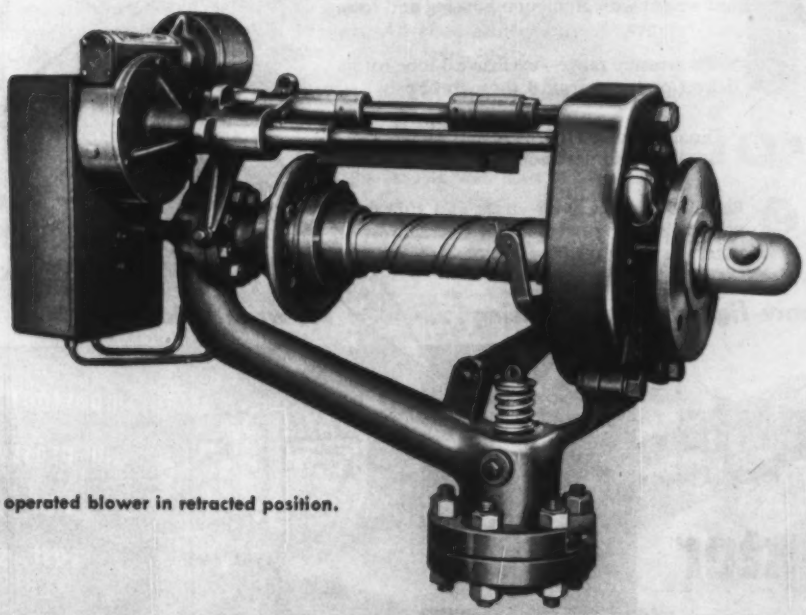
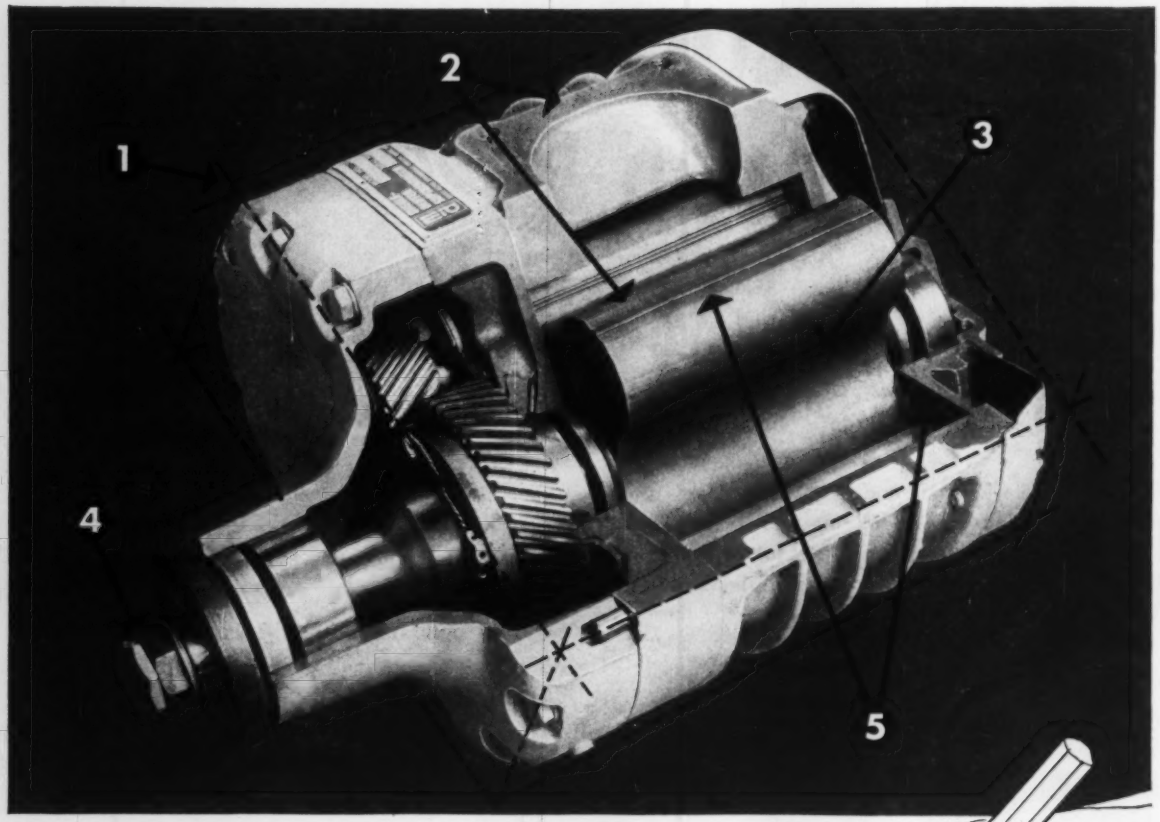


Air motor operated blower in retracted position.



The BIG difference in blowers is...

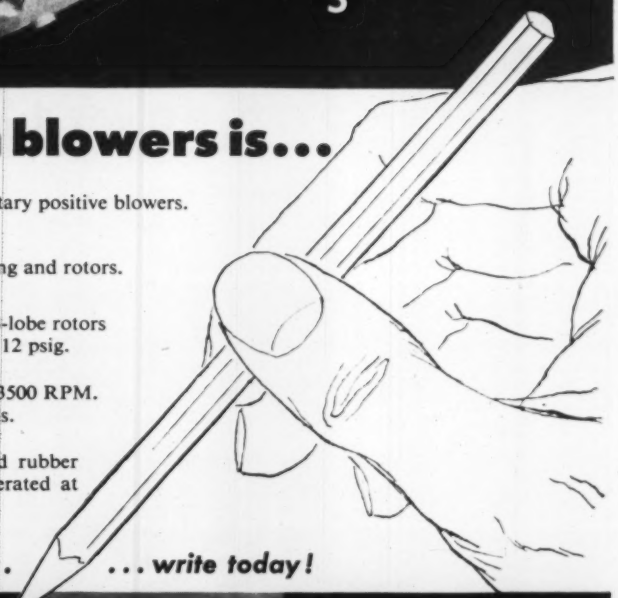
HERE 1 Smallest cube dimensions of all rotary positive blowers.

HERE 2 Lightest weight with aluminum housing and rotors.

HERE 3 Wide pressure range—exclusive 3-lobe rotors deliver pressures from 1 through 12 psig.

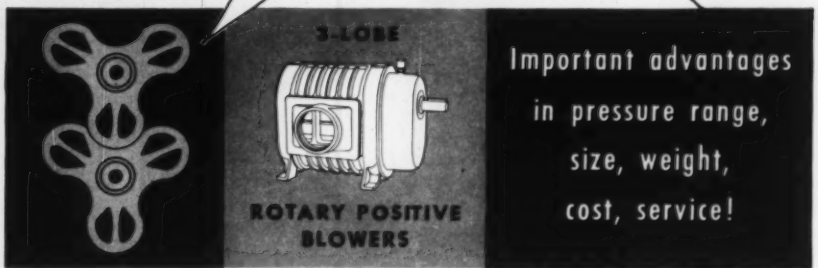
HERE 4 Direct drive at 1160, 1750 and 3500 RPM. Belt drive at intermediate speeds.

AND HERE 5 Patented formica wear strips and rubber grid seals prevent freezing if operated at excessive pressures.



The performance figures are convincing... ...write today!

Miehle Dexter



Miehle-Dexter Supercharger Division of The Christensen Machine Company, 100 Fourth St., Racine, Wis.

Black that's born BLACK...

Imported CASTELL is saturated with "black gold" — the best natural graphite of more than 99% pure carbon

Only the best natural "black gold" graphite — mined out of the earth just as gold and silver is mined — goes into imported CASTELL. Because it assays at more than 99% pure carbon, we are not obliged to add foreign oily substances to create the *illusion* of black. CASTELL is *born* black.

That's why it gives you clean, crisp, extremely opaque lines that do not feather or crumble — why you do not have to pause frequently to brush away graphite dust.

Microlet-milling, our own exclusive process, reduces the granules to perfect shape and cohesion, giving you *light-proof* lines of unvarying density for the maximum of cleaner, sharper blueprints . . . lines with remarkable *erasability* that leave no ghosts. The close-textured lead sharpens to a needlepoint and resists breakage even under extra heavy pressure. 20 scientifically-uniform degrees, 8B to 10H.

You owe it to your career to use CASTELL, the Drawing Pencil of the Masters. All good dealers carry CASTELL. Why not call *yours* today.

CASTELL LOCKTITE (with Tel-A-Grade Indicator) for those who prefer a feather-weight holder with degree indicating device. Grips the lead like the jaws of a bulldog to prevent slipping or turning. One hand push-button control reduces graphite stains.

Imported CASTELL 9030 Lead — with the identical graphite that made Castell wood pencil world famous. Usable in all standard holders, but a perfect mate with LOCKTITE. Also available in a kaleidoscope of colors. Packed in plastic tube, 12 leads each.

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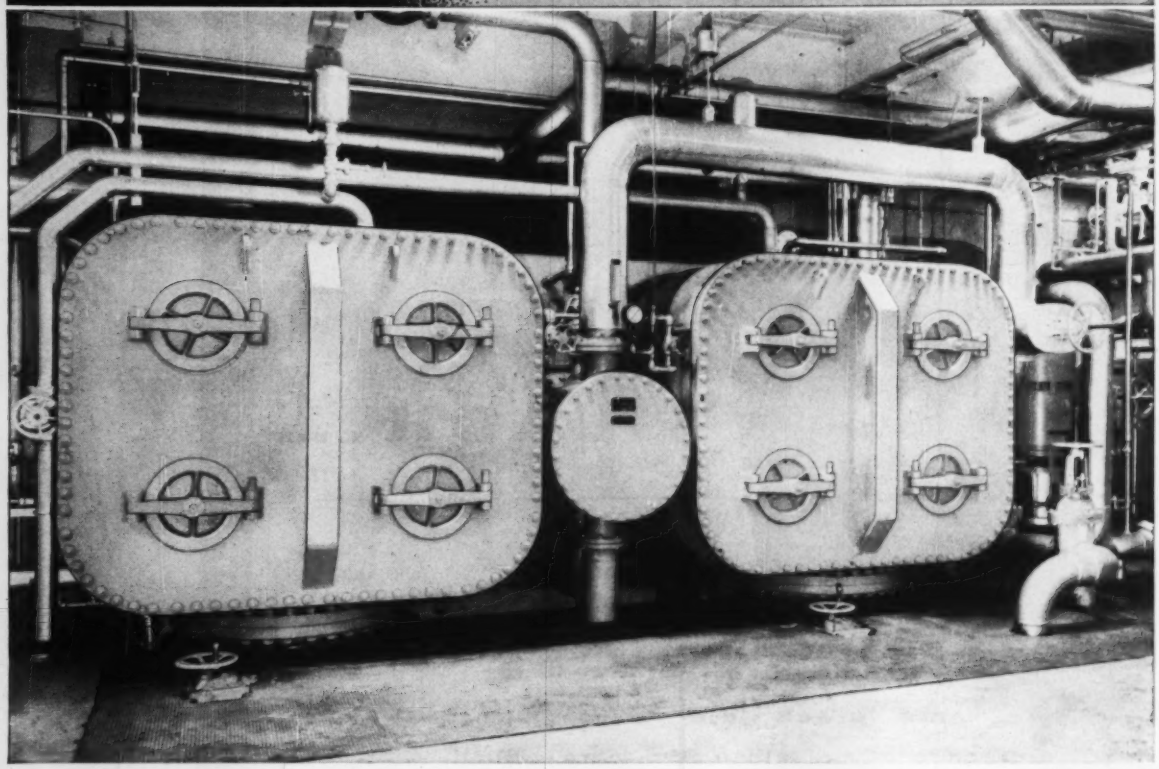
PROGRESS IN POWER through PROGRESS IN HEAT TRANSFER EQUIPMENT



NEW-DESIGN CONDENSERS SAVE SPACE AND MONEY

Steam generation of electricity has made tremendous progress in the last 25 years because of the ever-increasing efficiency of the equipment used.

A power equipment manufacturer with many "firsts" to its credit, Yuba is continually designing, among other equipment, condensers with low head room to save much-needed space. This advancement is illustrated above in the photograph of a rectangular shape condenser for the Suwanee River Plant of the Florida Power Corp.

A low pressure heater is installed between the tube banks to further save plant space, as well as initial cost for foundation and piping. An additional design feature of Yuba condensers is a de-aerating section within the condenser shell which eliminates the main plant de-aerating heater. Maintenance and downtime costs are reduced by welding tubes into tube sheets.

For advanced condenser design, that will save space and money, consult the Yuba Heat Transfer Division, formerly the Heat Exchanger Division of The Lummus Co.

YUBA HEAT TRANSFER DIVISION

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SPROCKETS and CHAIN in the full range required for drives from 1/4" to 2" Pitch

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NOW — you can meet any drive need — light to heavy duty — with standardized roller, block, or ladder chain and sprockets OFF-THE-SHELF from your BOSTON GEAR DISTRIBUTOR — AT FACTORY PRICES.

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TERRY SOLID WHEEL

and all its advantages

When it comes to judging a turbine's ability to deliver in vertical service, ratings tell only half the story. It's the Terry construction refinements that give you assurance of long-range operational economy: Thrust bearing designed to absorb external pump thrusts ... carbon ring glands specially made for vertical operation ... casings and bearing housings split vertically for easy accessibility.

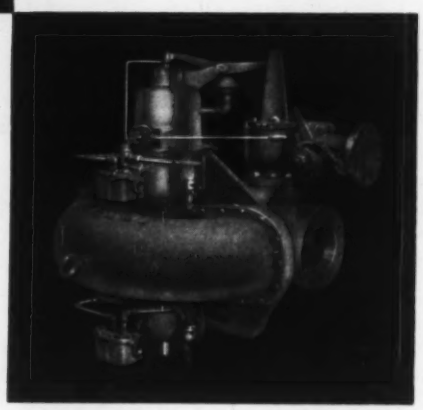
But most important, the Terry vertical turbine has an *almost* indestructible rotor. A single forging of special composition steel, it has no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

If your application demands a vertical turbine, specify Terry solid wheel. Available in capacities from 5 to 300 horsepower. And remember, the extra durability built into these vertical turbines is typical of every turbine in the complete Terry line.

For further information, send for a copy of bulletin S-137.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



TT-1210

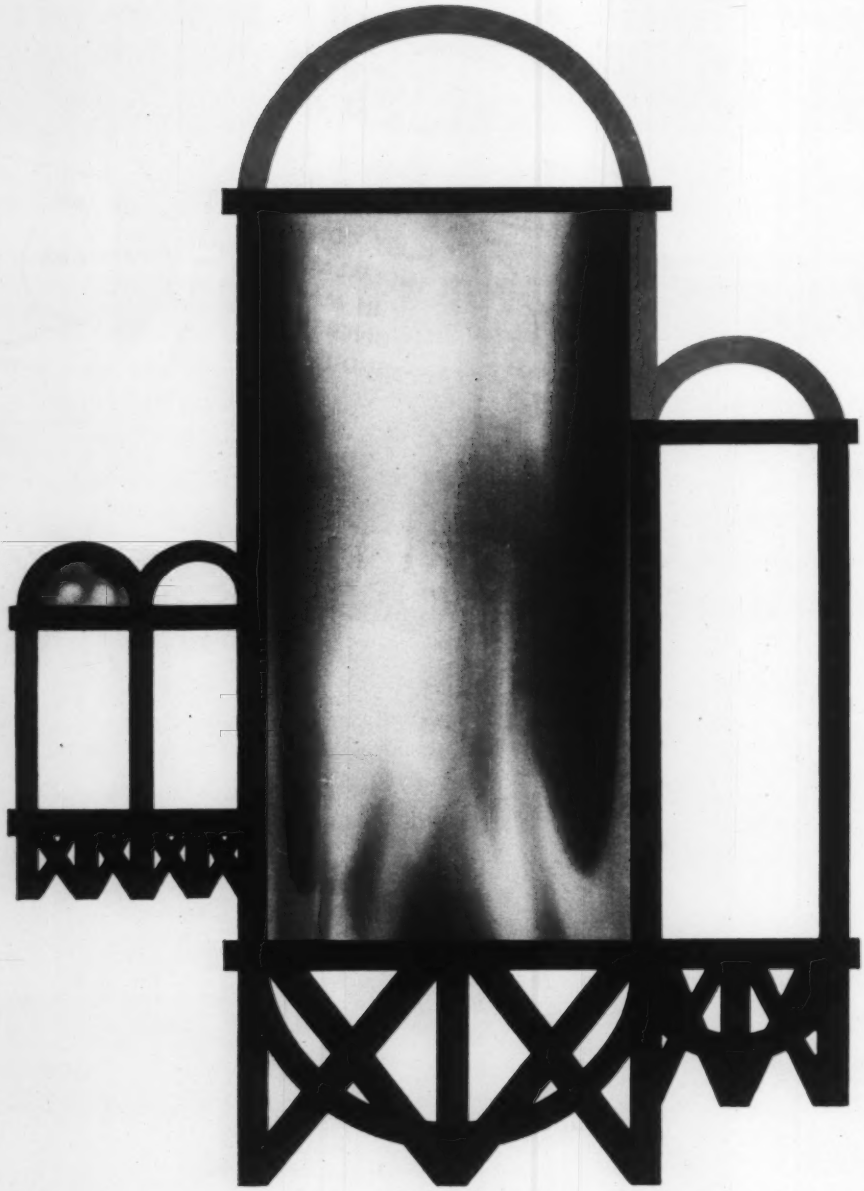
Here's why Pangborn Dust Control boosts employee morale!

The answer is in this book. You'll see why Pangborn Dust Control makes your employees happier, healthier, more efficient in a dust-free plant. Why machinery life is lengthened, housekeeping costs reduced. Why you can reclaim valuable material for salvage. Why you can improve community relations.

Why *Pangborn* Dust Control? Because Pangborn offers the most efficient methods of dust collection on the market. Pangborn has spent 50 years dealing with dust problems . . . experience that is incorporated in every proposal. And Pangborn's extensive line of wet and dry collectors means that one of these units can be adapted with maximum effectiveness to *any* problem.

Send for your *copy of "Out of the Realm of Dust." And remember: the Pangborn Engineer in your area will be glad to take off his coat and go to work on your dust problem at no obligation.* PANGBORN CORP., *2200 Pangborn Blvd., Hagerstown, Md. Manufacturers of Dust Control and Blast Cleaning Equipment.*

Pangborn CONTROLS **DUST**



win the fight against corrosion—with Alcoa Aluminum

Chances are the staggering cost of corrosion is your most serious headache. If so, don't overlook this important possibility: there is probably a known—and proved—economical aluminum answer to your most serious corrosion problem. Alcoa engineers can show it to you.

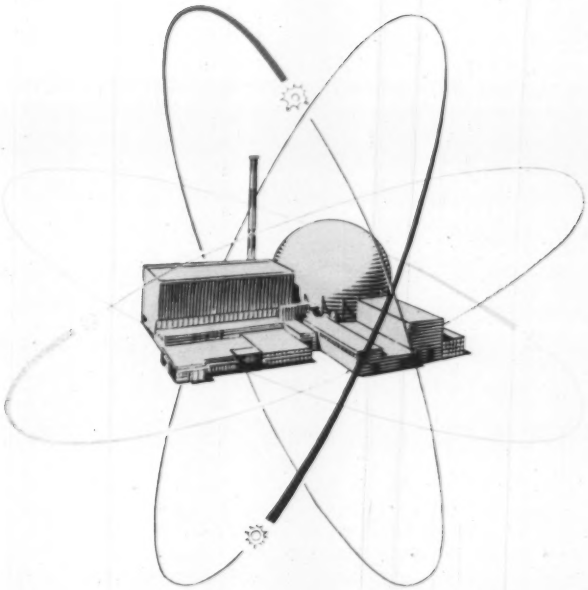
Alcoa's corrosion specialists have accumulated over 1000 man-years' experience applying aluminum to solve corrosion problems in the process industries. Their unequaled experience has produced an immense fund of factual data on the behavior of aluminum with corrosive materials and in corrosive atmospheres. That data is at your service.

Let Alcoa's engineers show you how to *win the fight against corrosion—with Alcoa® Aluminum.* Outline your corrosion problems in a letter to ALUMINUM COMPANY OF AMERICA, 894-C Alcoa Building, Pittsburgh 19, Pa.

"ALCOA THEATRE"
Exciting Adventure
Alternate Monday Evenings

ALCOA ALUMINUM

Specify Alcoa Aluminum for
corrosion-free Process Equipment
Pipe & Tube
Tanks, Containers, Trucks & Cars
Plant Structures



LADISH

IS THE FIRST NAME IN

Controlled Quality

PIPE FITTINGS FOR

NUCLEAR AND CONVENTIONAL

POWER INSTALLATIONS

LADISH

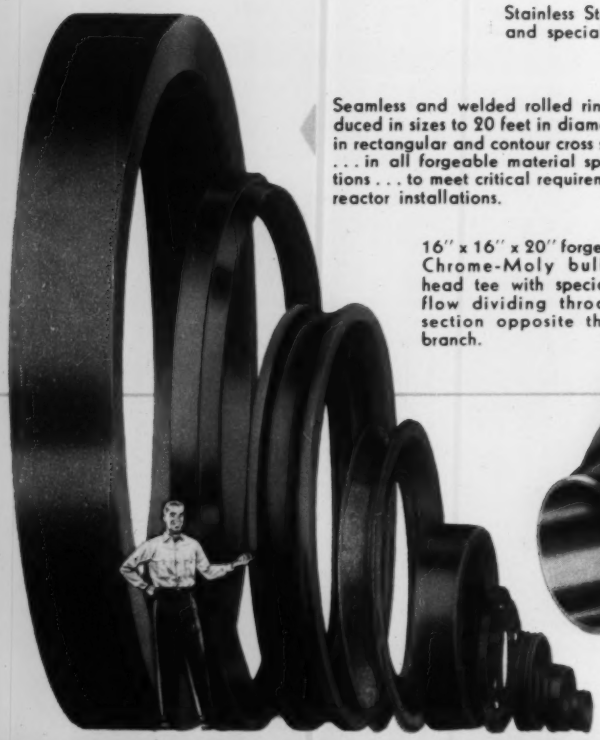
...THE RECOGNIZED, DEPENDABLE SOURCE FOR

18" alloy steel elbows with 3.9" wall for extremely high pressure-temperature service.

Heavy wall laterals closed impression die forged of Stainless Steel in a variety of sizes.

Stainless Steel, heavy wall, reducing tee with extended run section.

Stainless Steel Elbow with heavy wall and special radius for nuclear service.



Seamless and welded rolled rings produced in sizes to 20 feet in diameter . . . in rectangular and contour cross sections . . . in all forgeable material specifications . . . to meet critical requirements of reactor installations.

16" x 16" x 20" forged Chrome-Moly bull-head tee with special flow dividing throat section opposite the branch.

Heat exchanger tube sheet of Stainless Steel. Forged weight — 4220 pounds.

Unusual Fittings

FOR NUCLEAR AND CONVENTIONAL POWER PIPING APPLICATIONS

Ladish is widely recognized as a prime, dependable source for a broad range of special-purpose fittings and forgings to meet unusual piping problems.

The fittings shown here were developed in close collaboration with the engineering staffs of firms pioneering in the design of modern conventional power plants and nuclear power installations.

Ladish has extensive experience and unequalled facilities for forging, machining and testing . . . small and large, simple and complex parts, in virtually every forgeable material . . . under precise metallurgical and manufacturing controls.

Type 304L Stainless Steel Nozzle, drop forged and machined to precision tolerances.

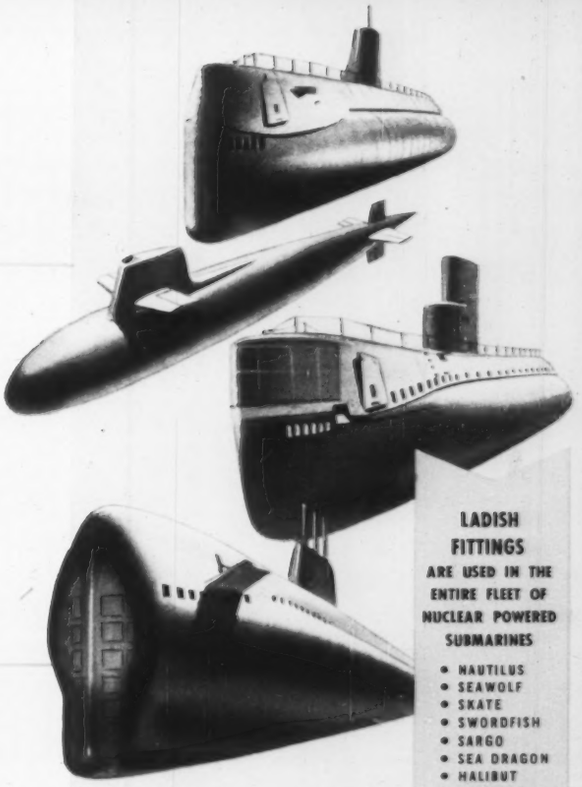
Titanium pipe fittings produced for a number of critical piping installations requiring positive resistance to extremely corrosive media.

Largest closed impression die forging produced to date. Weight — 10,500 pounds . . . 316 Stainless Steel. For use in modern power plants operating at elevated pressures and temperatures.

L

TO MARK PROGRESS

Intricately shaped Stainless Steel heat exchanger heads. Drop Forged and machined to close tolerances by Ladish.



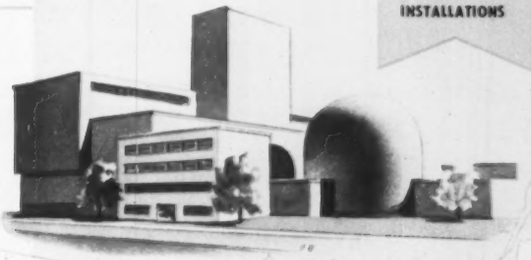
LADISH FITTINGS ARE USED IN THE ENTIRE FLEET OF NUCLEAR POWERED SUBMARINES

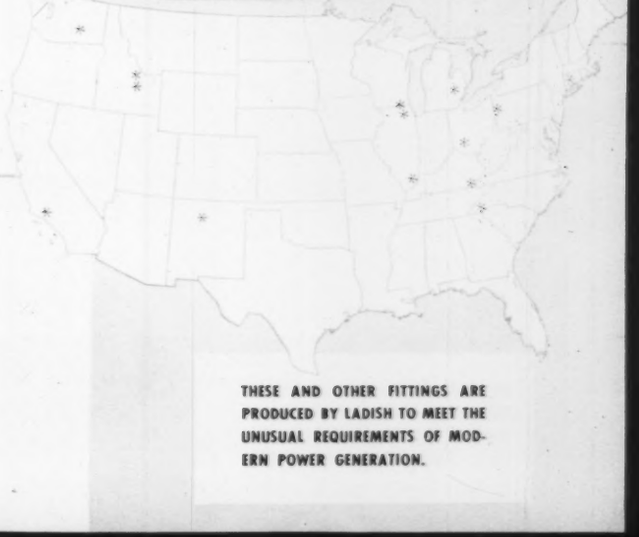
- NAUTILUS
- SEAWOLF
- SKATE
- SWORDFISH
- SARGO
- SEA DRAGON
- HALIBUT
- SKIPJACK
- TRITON

...AND IN PROTOTYPE REACTOR SYSTEMS FOR SURFACE SHIPS

HANFORD • OAK RIDGE • ARGONNE
LOS ALAMOS • PADUCAH
DRESDEN • SANTA SUSANA • DETROIT
SAVANNAH RIVER • PORTSMOUTH
NATIONAL REACTOR TEST STATION
SHIPPINGPORT • BROOKHAVEN

LADISH CONTROLLED QUALITY FITTINGS IN A.E.C. NUCLEAR REACTOR INSTALLATIONS





THESE AND OTHER FITTINGS ARE PRODUCED BY LADISH TO MEET THE UNUSUAL REQUIREMENTS OF MODERN POWER GENERATION.

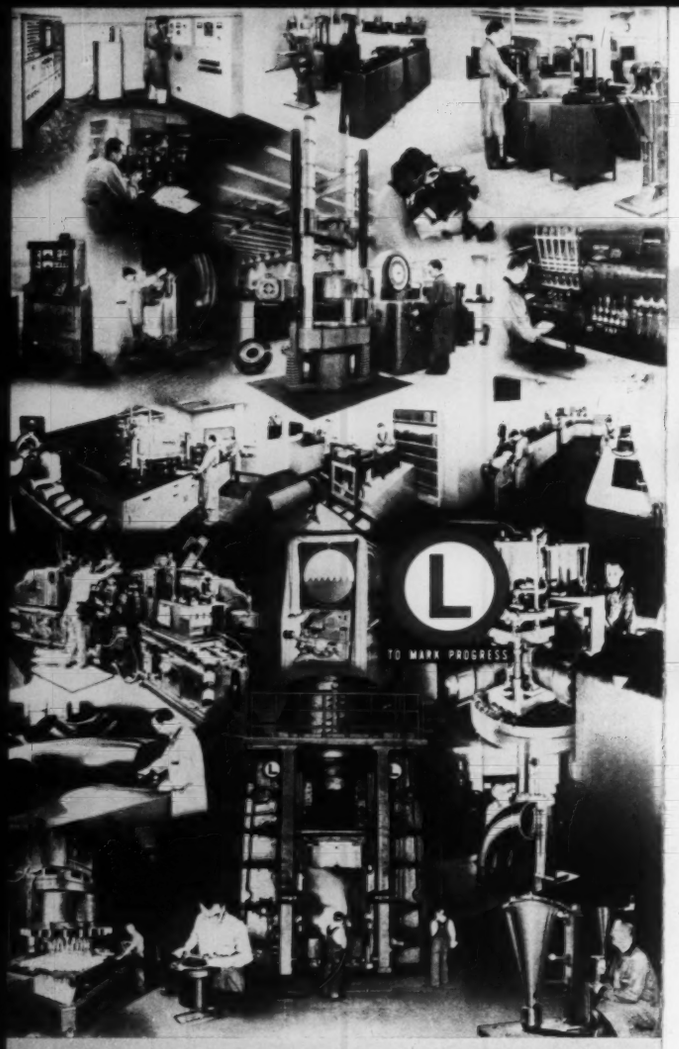
LADISH CO.

CUDAHY (Milwaukee Suburb) WISCONSIN

Serving the West . . . Ladish Pacific Division, Ladish Co., Los Angeles, Calif.
Serving Canada . . . Ladish Co. of Canada Ltd., Brantford, Ontario

Complete Service in *Controlled Quality* Fittings

WELDING FITTINGS	ASA & MSS FLANGES	SCREWED and SOCKET FITTINGS and UNIONS	LONG NECK FLANGES	TEMA & LARGE O.D. FLANGES & ROLLED RINGS



PRODUCED TO OPTIMUM STANDARDS OF METALLURGICAL INTEGRITY AND MANUFACTURING QUALITY...

Outstanding reliability . . . a distinguishing feature of Ladish fittings . . . is the direct result of a combination of skilled craftsmen, Controlled Quality methods, unmatched laboratory and production facilities.

Each step in production from initial verification of material analysis through final inspection is controlled by an extensive staff of quality-conscious metallurgists and engineers.

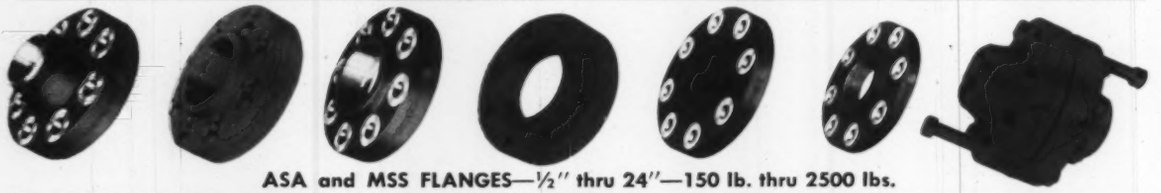
This continuous painstaking control of production processes assures metallurgical integrity and conformity to specifications.

LADISH *Controlled Quality* PIPE FITTINGS

CARBON STEELS • ALLOY STEELS • STAINLESS STEELS • ALUMINUM
TITANIUM • INCONEL • AND WIDE RANGE OF FORGEABLE MATERIALS

IPS BUTT WELDING FITTINGS—½" thru 42"—Sch. 5S thru 4" walls

TUBE O.D. WELDING FITTINGS—½" thru 36"—.049" thru .250" walls



ASA and MSS FLANGES—½" thru 24"—150 lb. thru 2500 lbs.

LARGE O.D. and TEMA FLANGES—
Up to 20' in diameter

LONG WELDING NECK FLANGES—
1" thru 24"—150 lb. thru 2500 lbs.

SCREWED and SOCKET TYPE FITTINGS and UNIONS—⅛" thru 4"—150 lb. and 2000 thru 6000 lbs.

LADISH CO.

CUDAHY (Milwaukee Suburb) **WISCONSIN**

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Serving Canada: **LADISH CO. OF CANADA LTD.,** Brantford, Ontario

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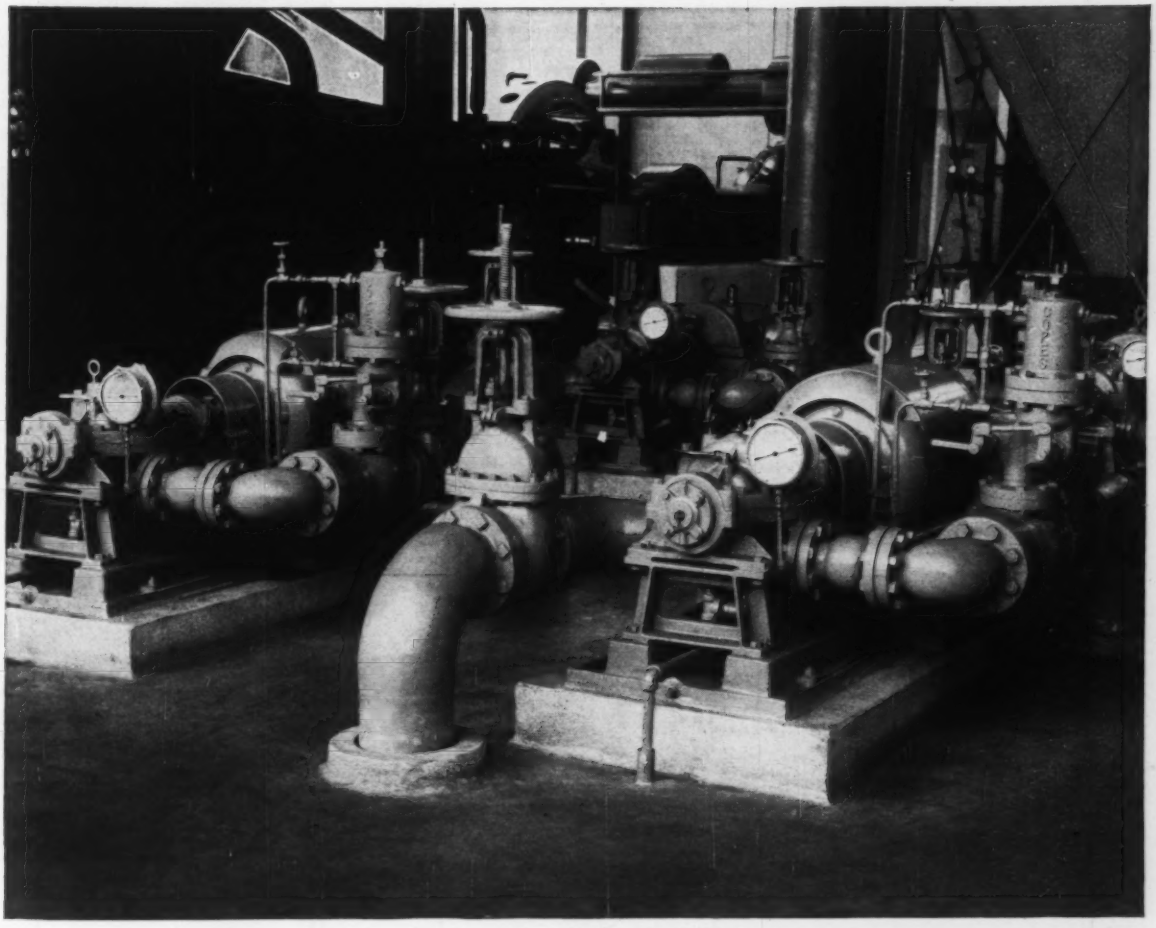
- PHILADELPHIA
- PITTSBURGH
- ST. LOUIS
- ST. PAUL
- SAN FRANCISCO
- SEATTLE
- TORONTO
- TULSA



"Buffalo" Type RR Pumps on boiler feed at a large auto plant

"BUFFALO" – THE PUMPS THAT DON'T MIND BEING IN HOT WATER AND UNDER PRESSURE!

In selecting boiler feed pumps of both peak efficiency and year-after-year durability, under pressure, pick the make with the 80-year record for these characteristics — "Buffalo". This long experience in designing and building centrifugal pumps for industry has resulted in present-day "Buffalo" Pumps with every feature for maximum delivery at least power input — and for continuous service with negligible maintenance.

"Buffalo" Type RR two-stage and four-stage pumps have the typically efficient, balanced "Buffalo" impellers — the oversize bearings and shafts — the rugged casings with simply formed water passages and deep 8-ring stuffing boxes. Write for Bulletin 980 and see why we say there's no better buy!

Boiler feed pumps for pressures to 500 psi

BUFFALO PUMPS
Division of Buffalo Forge Co.
148 MORTIMER STREET, BUFFALO, N. Y.
Canada Pumps, Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

1500-ton hydraulic free-forging press in operation at one of the leading mills for specialty steels. Manipulator is at left, high-pressure water station at rear, scale remover chute at bottom.

Because the new specialty alloy steels must be metallurgically perfect . . . Loewy forging presses

New alloys are coming into existence continually. Each is developed for unusual requirements—each has a different application.

Advances in the missiles field and in nucleonics demand the newest methods to produce these high-quality alloys. Specific service conditions, such as temperature range, stresses, corrosion by gases and nuclear liquids, all call for special properties—sometimes for unusual combinations of them.

Loewy forging presses assure metallurgical perfection of the product. It is generally agreed in the trade that—as one of our customers put it—our presses "*impart to special steels internal qualities never before achieved.*"

Loewy forging presses are designed for full accessibility of tooling, for easy supervision and maintenance. Fast closing, working and return speeds cut down idle time and prevent heat loss in the workpiece. Strokes per minute for planishing are unsurpassed by any other type of forging equipment. Pressure, tonnage and speed can be varied within a wide range to suit special requirements.

On Loewy presses, the machine parts exposed to the heat of the workpiece are protected and allow for thermal expansion. Heaviest eccentric loading is provided for. Any likelihood of fatigue failure is removed by careful design analysis. Loewy hydraulic forging presses have repeatedly proved that they outproduce hammers in working specialty alloy steels.

Loewy designs and builds open and closed die forging presses ranging from the much publicized 50,000-ton-capacity giant at Wyman-Gordon to a 660-ton midget in the same shop.

For information on how Loewy forging presses can solve your production problems, write us today, Dept. F-3.

Loewy-Hydropress Division

BALDWIN · LIMA · HAMILTON

111 FIFTH AVENUE, NEW YORK 3, N.Y. Rolling mills • Hydraulic machinery • Industrial engineering

BALDWIN BLH LIMA-HAMILTON

FARVAL—*Studies in Centralized Lubrication*
No. 218

Farval lubrication first choice for Hill-Acme Upsetter

On this 1¼-inch Hill-Acme Upsetter, Farval's timing cycle can easily be changed to conform with the service of the macnine. Amount of lubricant delivered to each bearing is also adjustable.

BUILDING peak performance into their machines is a point-of-pride with Hill-Acme. That's why you'll find Farval lubrication systems on H-A machines such as this upsetter.

When the going's rugged, with shock, vibration and wear trying to take their toll, Farval continuously guards 59 vital bearings . . . continuously delivers measured amounts of lubricant at regular intervals.

More and more, machine designers, engineers and production men are turning to Farval for the kind of lubrication that spells uninterrupted, maintenance-free production. Let us tell you more. Write for Bulletin 26-S. The Farval Corporation, 3264 East 80th Street, Cleveland 4, Ohio.

KEYS TO ADEQUATE LUBRICATION

Wherever you see the sign of Farval—familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine is being properly lubricated.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.

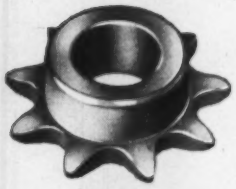
WHATEVER THE APPLICATION...

you can improve your product with

GRAMIX®

(PRODUCT OF POWDER METALLURGY)

PRECISION FINISHED PARTS



Hardened steel drive sprocket for lawnmower

Aircraft control cable guide

Self-aligning guide bearing for industrial blower shaft

GRAMIX precision finished parts are improving products in virtually every branch of industry. A pump manufacturer, for instance, may specify a gasoline pump rotor made of GRAMIX and gain a number of advantages.

To begin with, the alloys are carefully blended to meet his individual requirements. The GRAMIX parts are then die-pressed to exact shape, sintered under rigid control and finished to tolerances as close as .0005". (This process, of course, costs far less than machining, forging or casting.) The manufacturer can expect the GRAMIX gasoline pump rotor to do a better job because *all* GRAMIX parts are precision engineered and precision controlled from alloying to finishing.

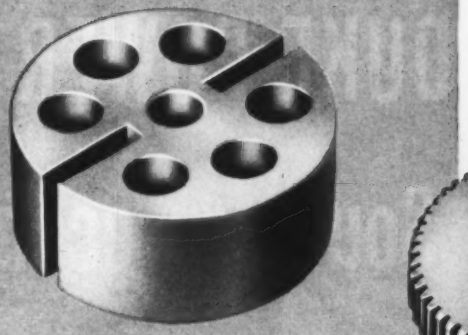
No matter what the application may be, GRAMIX parts fit specifications exactly. Parts may be impregnated with oil . . . to insure a longer life and a quieter operation: if specified, the GRAMIX parts may be coined and work hardened, even prepared for plating.

The rotor is only one of thousands of applications in which GRAMIX precision finished parts have proved to be ideal. Just a few of them are shown here, so consider the components of your products . . . there may be several that could be improved . . . with GRAMIX! Products of powder metallurgy you can rely on.

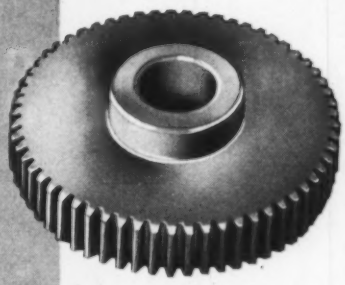
MEMBER

THE UNITED STATES

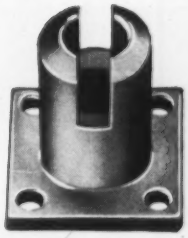
GRAPHITAR® CARBON-GRAPHITE • GRAMIX® POWDERED METAL PARTS • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES



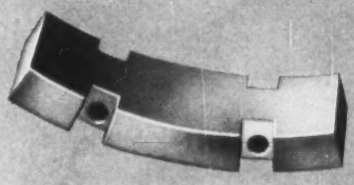
Automotive compressor rotor



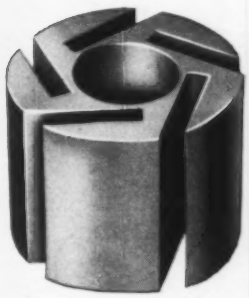
Infiltrated iron gear for lawnmower



Iron switch control

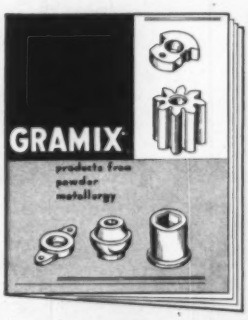


Iron clutch segment

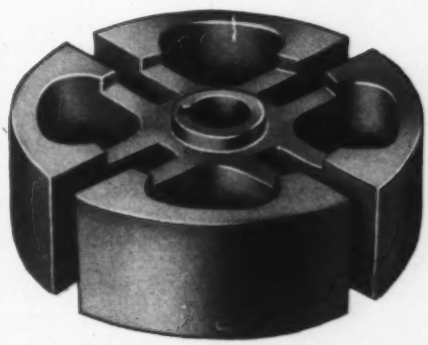


Rotor for gasoline pump

Packing gland follower used in hydraulic system



Write today for factual Engineering Bulletin No. 21 . . . we'll send your copy right along.



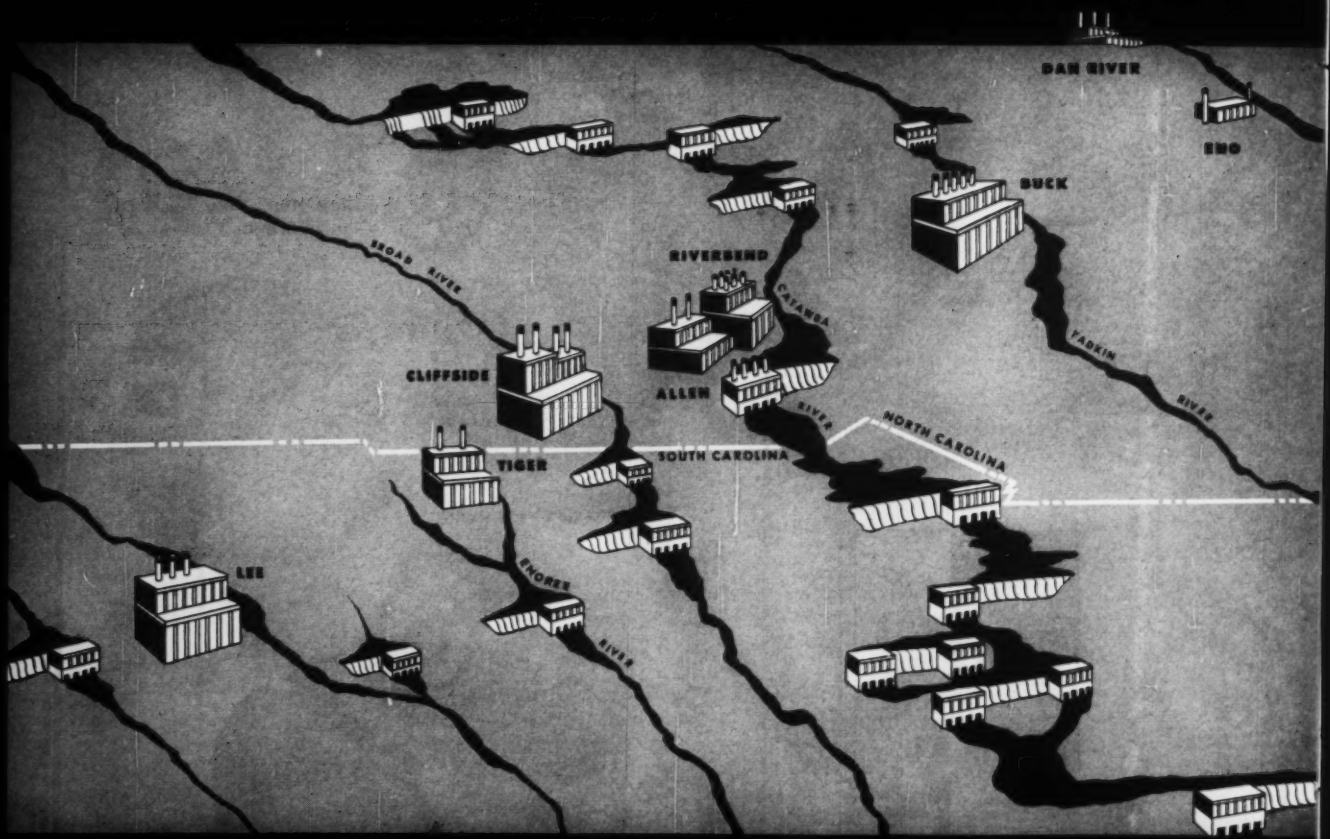
Bronze rotor in high speed fueling unit

X-253-1

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN

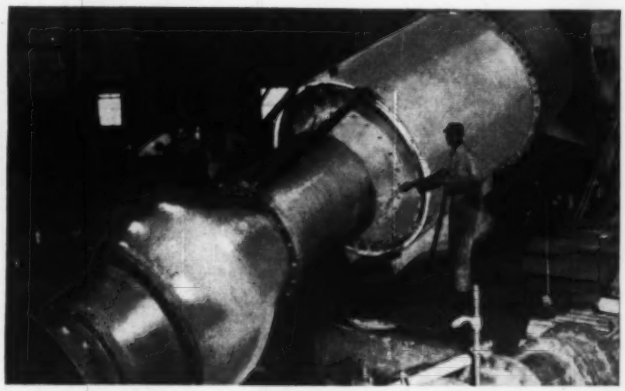
Still more power for DUKE POWER...
and the fast-growing Southern economy



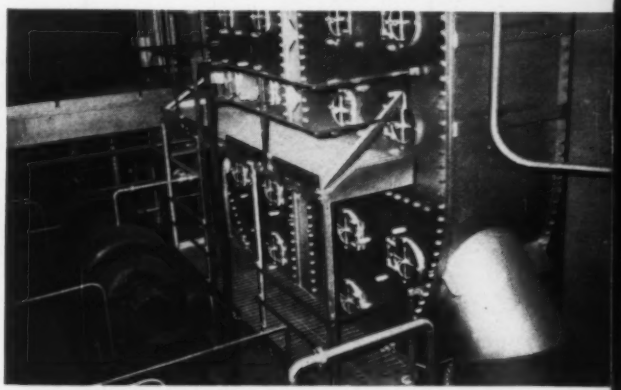
1,844,300 sq. ft. of C. H. Wheeler Surface Condensers are in use now or on order in the Duke Power System:

Station	No. of Condensers	Total Sq. Ft. Condensing Surface
ALLEN	4	530,000
BUCK	5	246,300
CLIFFSIDE	4	163,000
DAN RIVER	3	195,000
LEE	3	240,000
RIVERBEND	7	470,000
	26	1,844,300

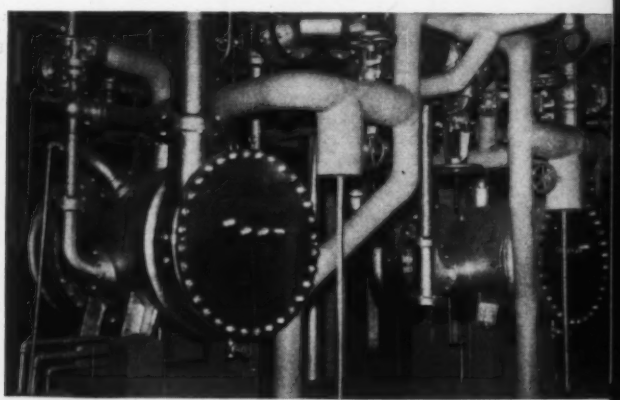
It's one of the south's greatest private power expansion programs—and C.H. Wheeler of Philadelphia is playing a leading part in it. To date, Wheeler has installed or is building 26 Dual Bank Surface Condensers, 5 Low Level Jet Condensers and a vast quantity of other power plant equipment. On the left is the story in tabular and geographic form; on this page are typical installation photographs of Wheeler equipment at Duke.



50-TON CIRCULATOR is one of 2 such pumps at Allen Plant Unit No. 1. It's a 48" x 54" Pull-Out Type Vertical Mixed Flow Pump. Capacity is 46,000 gpm. Two more of these pumps are being installed at Allen Plant Unit No. 2. The Allen Plant is the first plant in the Duke Power System to use vertical condensate pumps and circulating water pumps made by Wheeler.



AT DUKE POWER'S BUCK STATION are two C.H. Wheeler Dual Bank Surface Condensers with 75,000 sq. ft. of cooling area each. Wheeler Circulating Water Pumps are also in service at this Spencer, North Carolina Station. Other Surface Condensers at the Buck Station range in condensing area from 5000 sq. ft. (a house turbine unit) to 60,000 sq. ft.



C.H. WHEELER'S TWO-STAGE TUBEJET® Air Ejector (above) shown at Duke Power's Buck Station. These same type units have been used successfully at other power generating plants for over 30 years, with only routine maintenance. First cost and installation cost are low, installation is fast and operation simple.

ONE OF TWO 7-STAGE SPLIT CYCLE 18" x 10" Vertical Condensate Pumps (left) for Duke Power's Allen Plant Unit No. 1 ready for test. Each unit is rated at 2000 gpm against a 620-ft. total dynamic head at 880 rpm. The first three stages operate as a unit at 225-ft. head; the other four stages of each Condensate Pump operate as a booster pump at head of 395 ft.

C. H. Wheeler Mfg. Co.

19TH & LEHIGH AVENUE *Philadelphia 32, Pennsylvania*

Steam Condensers

Vacuum Equipment

Centrifugal, Axial & Mixed Flow Pumps

Marine Auxiliary Machinery

Nuclear Products

Help yourself

Simplified Guide and Data Charts covering **TAYLOR FORGE** Welding Fittings Forged Flanges

INFORMATION REQUIRED ON WRITTEN ORDER

Typical examples showing proper sequence and abbreviated nomenclature

Identification of Fittings—not required on order	Quantity	Size	Degree	Weight or SCH No.	Radius	Material	Name
90° Elbows, Long Radius	10	1"	90°	STD	LR	See ① below	WeldELLS
90° Elbows, Short Radius	14	3"	90°	X-STG	1-R		WeldELLS
45° Elbows	6	4x2"	45°	XX-STG			WeldELLS
90° Reducing Elbows ①	3	5"	90°	STD			Reduc WeldELLS
90° Long Tangent one end	2	6"	90°	X-STG			WeldELLS, Tee one end
90° Long Tangent both ends	8	8"	180°	STD			WeldELLS, Tee both ends
180° Returns, Long Radius	12	10"	180°	LIGHT WALL	LR		WeldELLS
180° Returns, Short Radius	16	12"		STD	1-R		WeldELLS
Tees, Straight	3	14x14x10"		SCH 40			Tees
Tees, Reducing ① ②	1	16x14"		SCH 20			Reduc Tees
Reducers, Concentric ① ②	2	12x8"		SCH 30			Con Reduc
Reducers, Eccentric ① ②	9	18"		SCH 40			Ecc Reduc
Lap Joint Stub Ends	14	10"		SCH 60			LJ Stub Ends
Caps	24	8"		SCH 80			Caps
Crosses, Straight	3	4x4x2x2"		SCH 100			Crosses
Crosses, Reducing ① ②	2	4"		STD			Reduc Crosses
45° Laterals, Straight	1	6x6x4"		X-STG			Laterals
45° Laterals, Reducing ① ②	6	8" on 10"		STD			Reduc Laterals
Welding Saddles	21	6"		X-STG			Saddles
Welding Sleeves	50 sets						Sleeves

① When ordering regular carbon steel fittings material need not be specified and fittings conforming to ASTM A234, Grade WPB, will be furnished. Any other material must be fully identified by applicable specification.

RANGE OF SIZES (Inches)

FITTING	STD & X-STG	XX-STG	LIGHT WALL & SCH 10 ①	SCHEDS 20, 30	SCH 40 ①	SCH 60	SCH 80 ①	SCH 100	SCH 120	SCH 140	SCH 160
90° Elbows, Long Radius	½–42	⅛–8	¼–30	8–30	12–24	8–24	10–24	8–24	4–24	8–24	1 –24
90° Elbows, Short Radius	1 –42	1½– 6		8–30	12–24	8–24	10–24	8–24	4–24	8–24	1¼–24
45° Elbows	½–42	1 – 8	¼–30	8–30	12–24	8–24	10–24	8–24	4–24	8–24	1 –24
90° Reducing Elbows ①	2 –16			8–16	12–16						
90° Long Tangent Elbows	1½–42			8–30	12–24						
180° Returns, Long Radius	½–30	1 – 8	¼–30	8–30	12–24	8–24	10–24	8–24	4–24	8–24	1 –24
180° Returns, Short Radius	1 –42	1½– 8		8–30	12–24	8–24	10–24	8–24	4–24	8–24	1½–24
Tees, Straight & Reducing ① ②	½–36	⅛– 8	¼–30	8–30	12–24	8–24	10–24	8–24	4–24	8–24	¼ –24
Reducers, Conc. & Ecc. ① ②	¼–42	¼– 8		8–30	12–24	8–24	10–24	8–24	4–24	8–24	1 –24
Lap Joint Stub Ends	½–42	¼– 8		8–30	12–24	8–24	10–24	8–24	4–24	8–24	1 –24
Caps	½–42	1 – 8									
Crosses, Straight & Reducing ① ②	1¼–24										
Laterals, Straight & Reducing ① ②	1 –24	1 –24									
Welding Saddles			Outlets for pipe sizes 1" thru 30" on header sizes 1¼" thru 30".								
Welding Sleeves			To fit no								

① Normal maximum reduction of Tees and Re... one nominal pipe size smaller than... large end size. For exceptions, see Catalog... Maximum reduction of Reducing WeldELLS... large end size.

Reducing on the run Tees, Crosses and La... made.

② When ordering reducing fittings to a Sch... thickness, note particularly whether si... branch or end is included in that Sched... the thickness of the branch or end ma...

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Wear Resistance is a common problem for designers, even when they're using a durable material like steel. Of course, it is well known that you can increase the abrasion resistance of a given steel when you improve its hardness (and thus, its strength). But when you harden and strengthen a steel so that it will resist wear, you usually run into some complications.

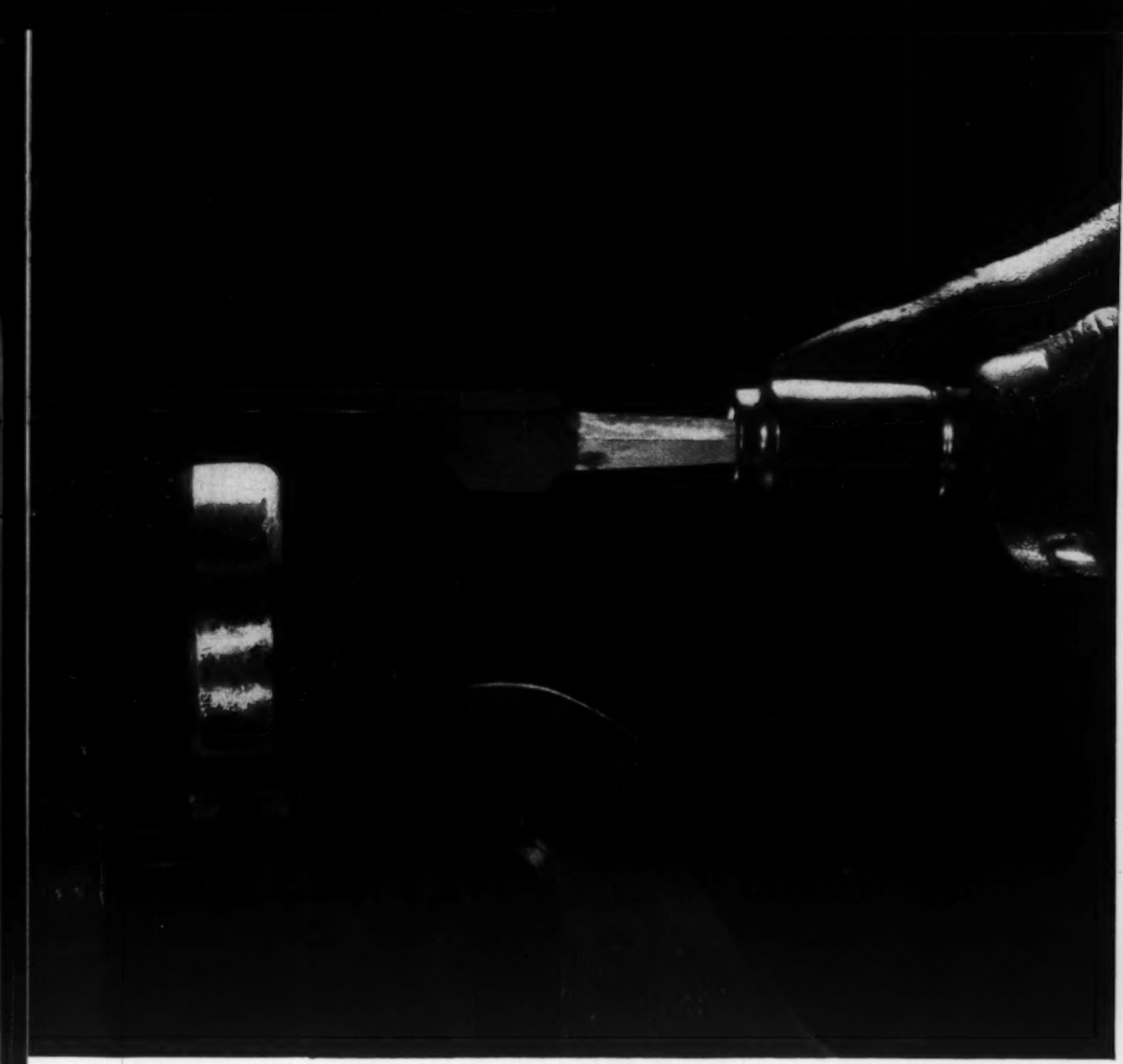
For instance, when we vary the wear resistance of steel, we also vary its *other* properties, and this causes problems for the designer or his metallurgical adviser. Examples: hardness and strength can be developed in various ways—increase the carbon content, add alloying elements, cold work, heat treat. These methods vary in cost, and each has a different effect on hardness, strength, toughness, corrosion resistance, formability and weldability.

There is one steel with the best combination of properties for every design application, and you're almost sure to find it in the vast range of USS Design Steels—whether Carbon, High Strength, Alloy or Stainless Steel. Here is the widest range of steels available, offered by a company that has produced well over a *billion* tons of steel.

Of course, over-design must be avoided as rigorously as under-design, and designers must always walk the prickly path between poor product performance on one hand and high costs on the other. Somewhere among the many USS Design Steels there is the one best steel for the job. The final selection can best be made with the help of a skilled metallurgist—either on your staff or ours.

USS **United States Steel**

STEELS FOR DESIGN

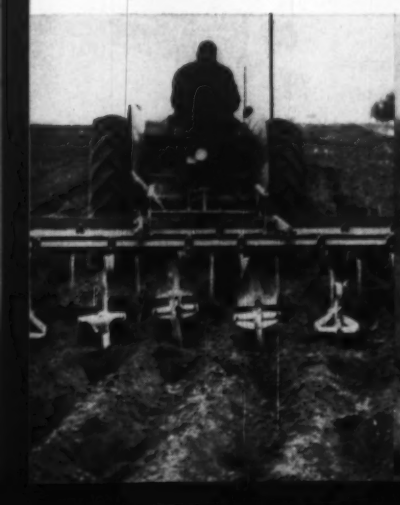


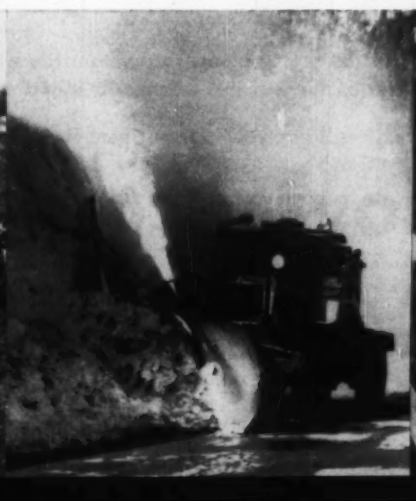
Lower Left—Problem: Blades on this earth dammer wore out after 300 acres. Solution: Blades are now made from USS MAN-TEN Steel, one of several USS HIGH STRENGTH STEELS. Benefit: Blades now last over 1,000 acres for Gunning Mfg. Co., Lansford, N. D.

Lower Middle—Problem. The new "Snow Hawg" rotary snow plow chews into ice, rock and frozen earth and throws it up to 300 feet. A weldable, very strong steel was needed to withstand the punishment. Solution: Vital parts are made from USS "T-1" Constructional Alloy Steel. It can be field-welded, and remains strong and tough down to minus 50°F. Benefit: Outstanding performance, and chute liners of the "Snow Hawg" last two to three times longer.

Lower Right—Problem: Chutes in a coal processing plant wore out prematurely due to abrasive action of coal and corrosion from acid water. Solution: Chutes made from USS Stainless Steel were installed. Benefit: New chutes outlast old ones seven to one. Atkins Coal Company, Frackville, Pa., estimates that a $900 investment in Stainless Steel chutes saved $30,000.

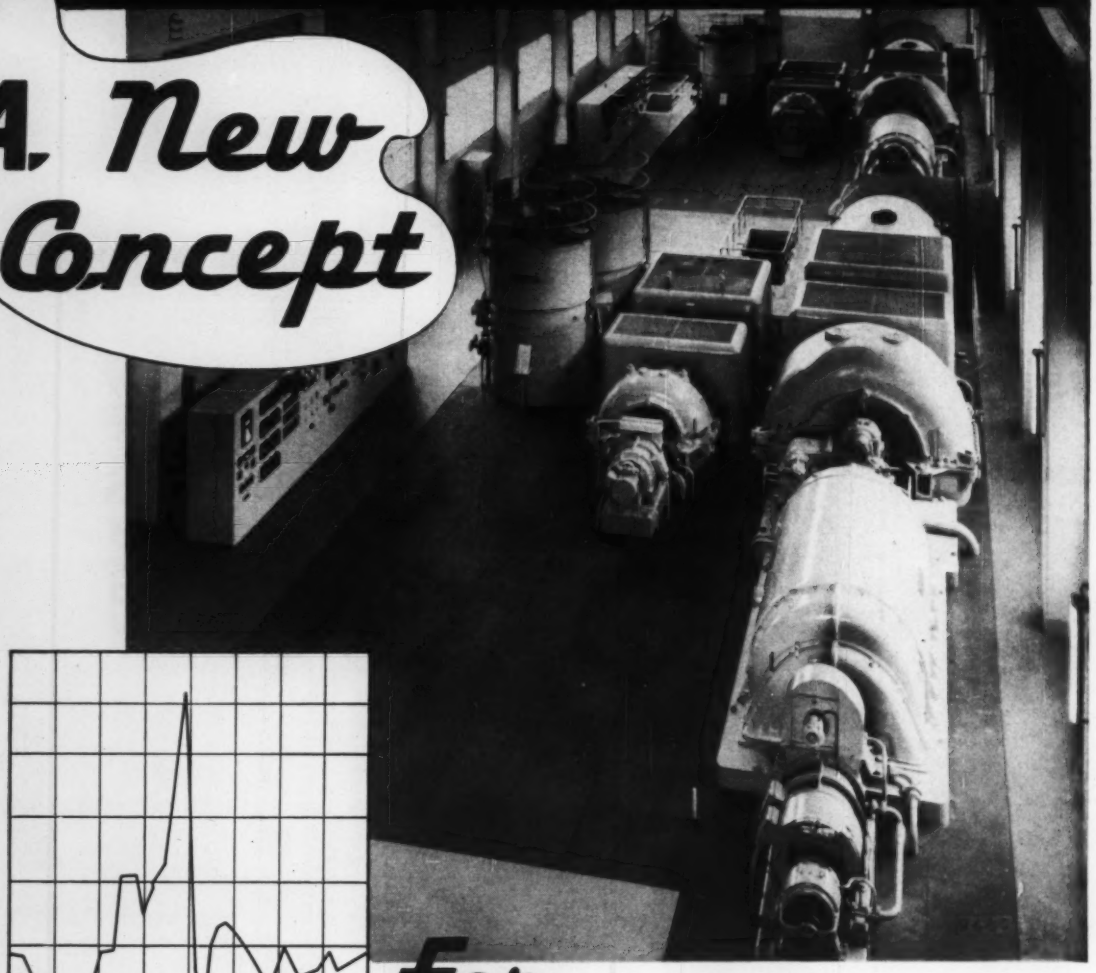
USS, MAN-TEN and "T-1" are registered trademarks of United States Steel





BROWN BOVERI GAS TURBINES

A New Concept



For Peak Loads

DEPENDING on the load, either the 7,000 kW single shaft or the 25,000 kW non-regenerative cycle Brown Boveri Gas Turbine provide the answer to the rigid demands of peak load service. *They can be put on the line in 20 minutes or less.*

Their on-the-job performance records—in over 60 power plants throughout the world—conclusively indicate not only economy of operation but sizeable savings in initial costs.

If your problem is *peak* or *base* load service, it will pay you to investigate Brown Boveri Gas Turbines.

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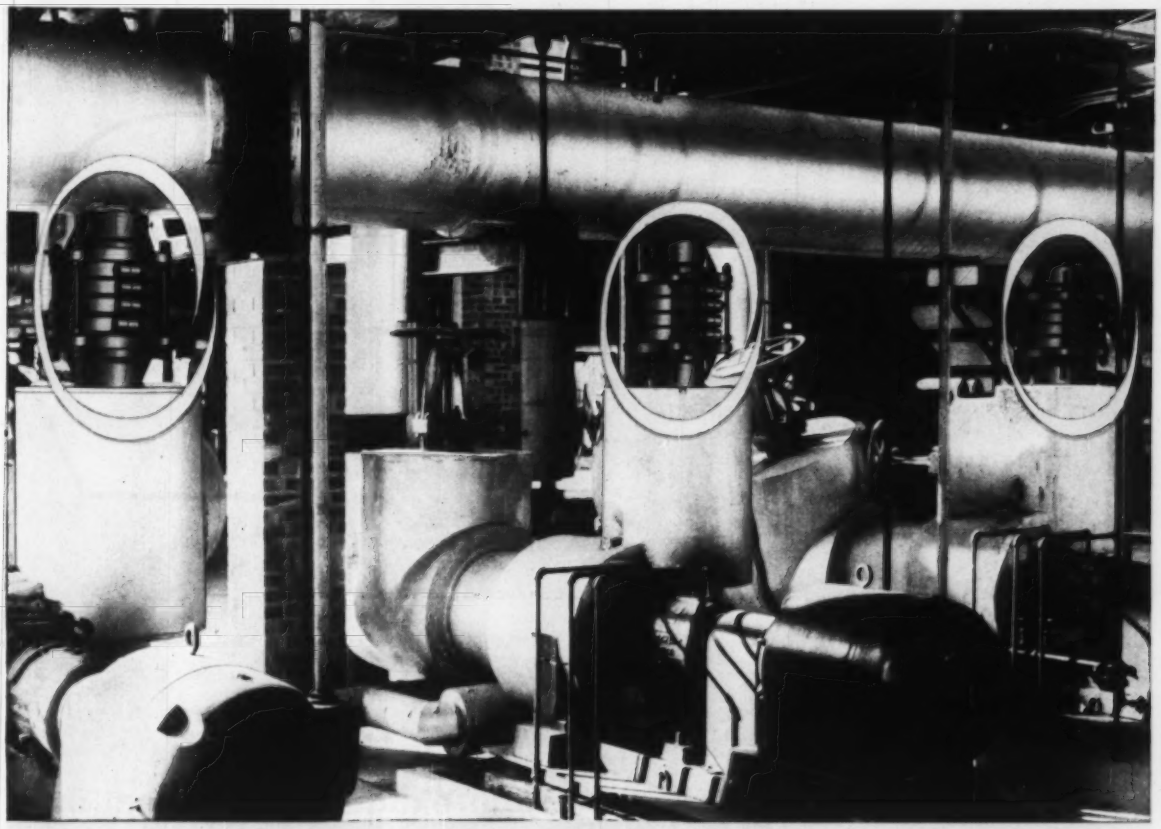

ADSCO CORRUFLEX EXPANSION JOINTS SOLVED A PIPING PROBLEM FOR NATIONAL ANILINE

The new $20,000,000 diisocyanates plant of the National Aniline Division, Allied Chemical & Dye Corp., at Moundsville, W.Va., is known for many engineering wonders, especially its miles of intricate piping. The photo above shows three ADSCO Corruflex anti-compression packless expansion joints used to secure satisfactory piping connections between the main piping and three pumps.

If rigid piping had been used to connect the three pumps to the 18-inch main feeder, the piping soon would have been twisted and overstressed by the growth of the main feeder when hot process liquid was pumped through it. National Aniline engineers, in consultation with ADSCO engineers, decided to use the anti-compression joints shown in the photo. These are deflected laterally with minimum strain on the connecting piping and pumps as the main feeder expands or contracts. Also, the joints absorb vibration of the pumps and motors.

For efficient, right-working pipe line arrangements, use ADSCO Corruflex expansion joints. Packless, they require no maintenance. Sizes, 3" to 54"; for temperatures to 1600 F and pressures to 300 psi.

REMEMBER! Use ADSCO Expansion Joints instead of Pipe Bends because of these advantages:

1. Less Heat Loss **2. Less Pressure Drop** **3. Less Space** **4. Less Cost**

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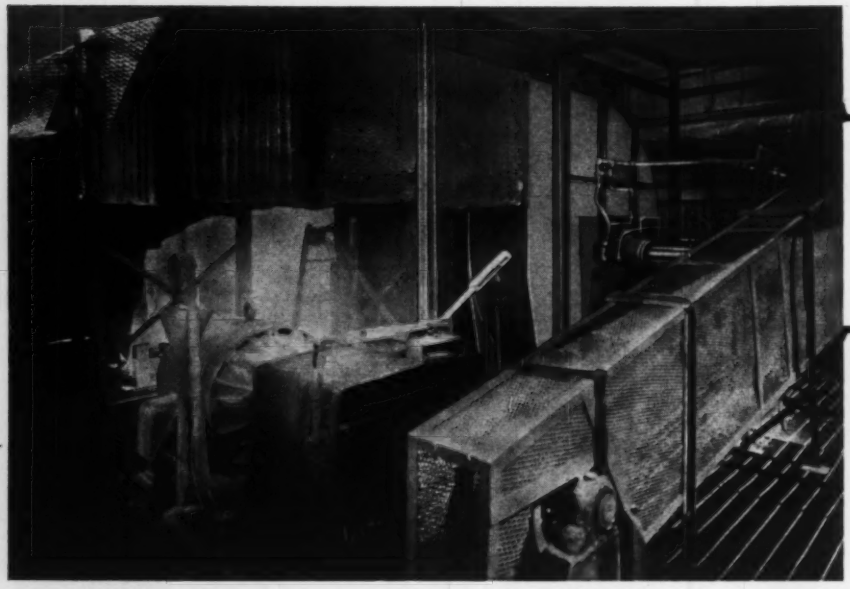


One of several Clarage Type XL Fans used in this application. Fan equipped with stainless steel wheel and V-belt driven from a hydraulic coupling.

Clarage Fans have what it takes

for this tough exhaust assignment in the production of titanium dioxide

Exhausting 800° F gases from rotary calciners through scrubber units and electrical precipitators to the atmosphere.

That's the demanding task this large chemical manufacturer gave Clarage Type XL Fans.

What kind of a job evaluation does Clarage receive? Several repeat orders furnish the answer. In fact, three additional Clarage Fans will soon be installed in a major expansion at this plant.

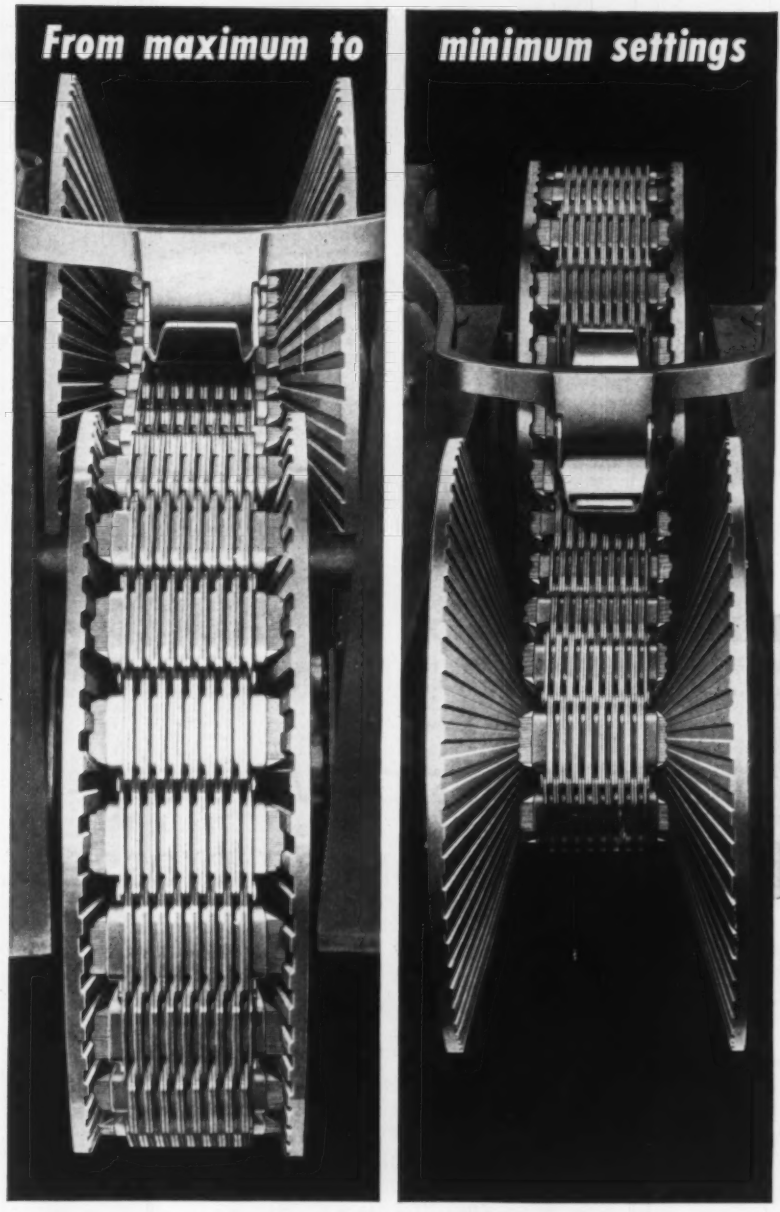
You, too, will find it pays dividends to choose the fan name of quality — Clarage. Call us in for capable assistance on your next requirements in the air handling and conditioning field. It's characteristic of Clarage equipment to prove out successfully no matter how exacting the application. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

For positive, accurate speed control

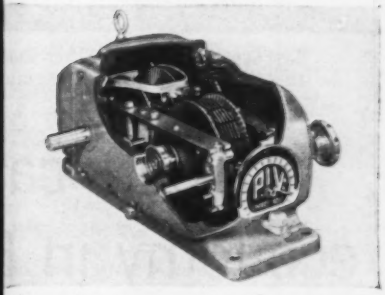
...there's nothing like P.I.V.



VARIABLE from top speed to minimum speed with no steps, no stops in between. That's Link-Belt P.I.V.—the *only* chain-driven variable speed drive. Teeth—not tension—permit instant ratio changes with no loss of speed, regardless of load conditions.

Slippage? Not a chance—P.I.V.'s chain-to-wheel grip is positive as a gear. In fact, this is industry's most accurate, most reliable mechanical variable speed drive.

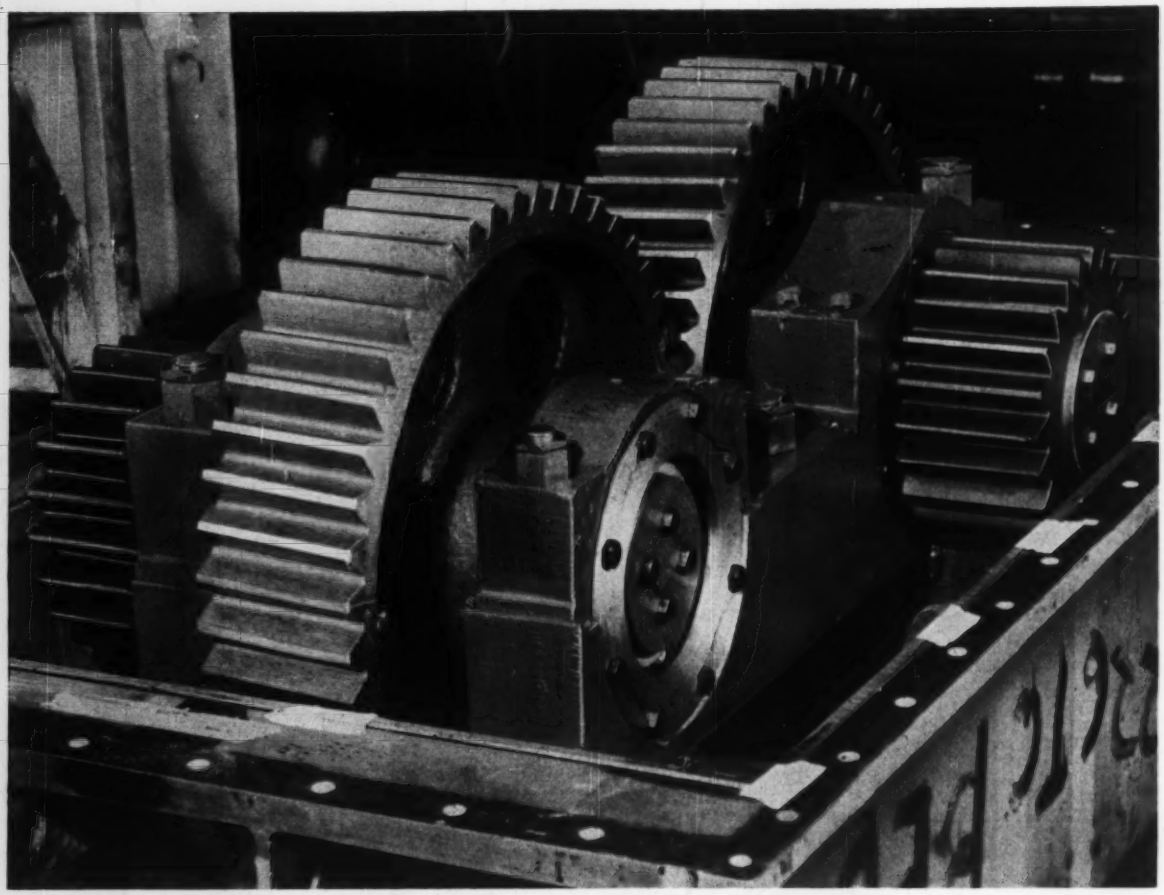
Your Link-Belt office or authorized stock-carrying distributor has Book 2274 on P.I.V. drives from ½ to 25 hp. Refer to the yellow pages of your local phone directory under Power Transmission Equipment.



HOW P.I.V. WORKS. Exclusive self-tooth-forming chain of P.I.V. consists of packs of free-sliding steel slats which serve as teeth. Chain grips beveled grooves on pairs of conical wheels located on input and output shafts. Speeds are changed by varying the effective diameters of the wheels, as shown at left.

P.I.V. LINK-BELT
VARIABLE SPEED DRIVE

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 14.513



Bliss Specifies Ductile Cast Iron Gears for presses used to form sheet steel for the auto industry. Bliss uses ductile cast iron for at least 10 other parts in top drive presses – 16 in under drive presses.

Ductile cast iron gears prove their economy in Bliss metal-working presses

The gears, illustrated above, are typical of the many ductile cast iron gears used by E. W. Bliss Co. of Canton, Ohio, for their heavy metal-working presses.

For 30″ to 108″ gears, ductile iron has provided outstanding service. It gives Bliss the best combination of properties: high strength, good castability, good wear resistance and excellent machinability. All this at moderate cost.

In this gear application, 80-60-03 grade ductile provides a yield strength of 60,000 psi – more than enough to meet the stresses developed in producing 300- to 4000-ton platen loads.

These ductile iron gears – heat-treated to 208 Brinell – work well with the 8640 (Ni-Cr-Mo) pinions, assuring top-notch wear resistance. Bliss reports, *"not a single ductile iron gear replaced since ductile iron was first specified."*

Take advantage of the economy of ductile cast iron for your equipment. For many applications – cylinders, pressure vessels, pistons and the like – ductile iron outperforms conventional materials. Cuts production time. Behaves better in the shop. Saves time and money.

For complete information write for "Ductile Iron – the Cast Iron that Can Be Bent."

DUCTILE D IRON

ductile iron . . . the cast iron that can be twisted and bent

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MECHANICAL ENGINEERING

VOLUME 80 • NUMBER 3 • MARCH, 1958

For Better Service To All

THE work at this conference . . ."will help the technologists of the United States maintain the prestige of our country in the cold-war era in which we live. The technological side of ASME life which you are fostering here certainly constitutes the hard central core of the reason for the existence of ASME." So stated James N. Landis, ASME President, as he opened the working sessions for the Fifth Technology Executives Conference, held January 5–7, 1958, at Arden House in Harriman, N. Y.

Purpose of the conference, as in the past, was to discuss problems confronting the Board on Technology and the Professional Divisions, Meetings, Publications, and Research Committees, and to provide guidance to committee members for their use during the year in carrying out the policies and aims of the Society.

These Conferences, conducted in a strictly informal atmosphere, have proved to be highly successful. The participants were free to discuss any and all operations of the Society—criticize procedures and policies, suggest means of improvement. New members of the various committees find these Conferences a practical way in which to obtain a working knowledge of the "hows," "whys," and "whens" of the functions of the various committees under the Board on Technology.

Here are some items of interest that were brought out during the Conference:

The Research Executive Committee pointed out that ASME does not engage in proprietary-type research nor in straight development work of particular interest to one company. Likewise, it is not in a position to support fundamental research along pure science lines. Rather, the research which ASME sponsors could be more aptly termed "background" research, which is of such a nature as to fill in the voids and gaps in the technology of various areas of mechanical engineering.

The Publications Committee, in its presentation, introduced a revised version of the ASME papers review report. In question-and-answer form, the new report is designed to permit better evaluation of the quality of papers to be presented and published.

Changes in the advance multilithed pamphlet papers for meetings were also outlined. The end result is a two-column saddle-stitched format which should greatly enhance the prestige of pamphlet papers as "permanent" publications.

The importance of meeting deadline dates for meetings was again stressed. There are now three dates (staggered) for each meeting.

The Professional Divisions Committee introduced the new Professional Divisions Manual, MS-11. This manual is a practical working guide for nearly any problem which may confront a Division.

An ideal technical meeting was proposed by the Meetings Committee. Such a meeting should include the following seven criteria: (1) High-quality, carefully selected, and conscientiously reviewed technical papers; (2) a convenient meeting location; (3) a nonconflicting meeting date; (4) advance publicity; (5) advance publication of papers; (6) adequate meeting space; and (7) a proper program balance of technical papers, social events, inspection trips, and lectures.

In addition, there were a discussion and evaluation of the Annual Meeting and a session on Division Conference planning.

Details on the foregoing points appear in this month's "ASME News" and should prove interesting and informative reading for both ASME committeemen and ASME members in general. It is through planning conferences such as these and the persevering work of the Society's countless committees that the technical life of ASME will continue to flourish—not only for the benefit of members but for the entire engineering profession.—*J. J. Jaklitsch, Jr.*

Editor, J. J. JAKLITSCH, JR.
Editor Emeritus, GEORGE A. STETSON

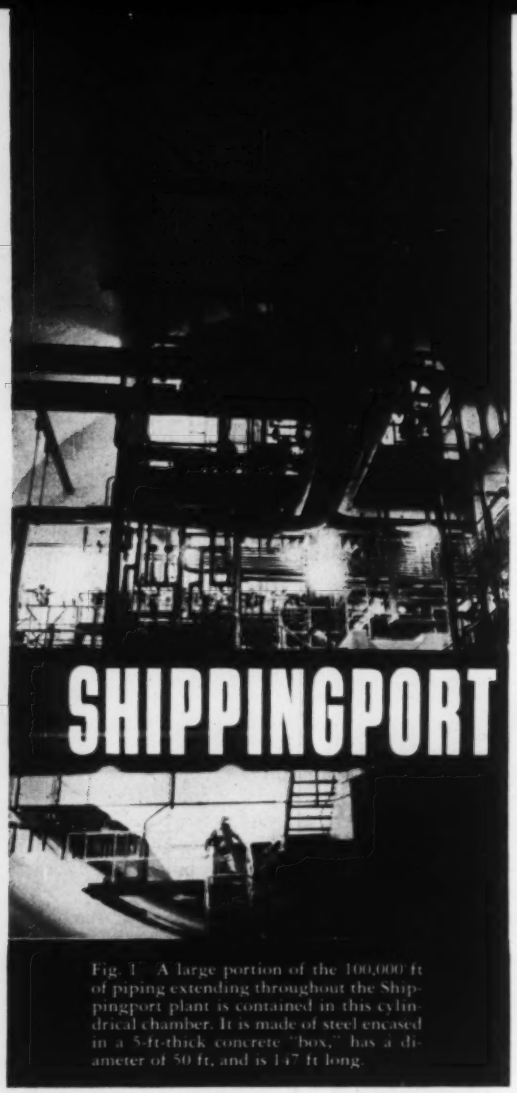


Fig. 1 A large portion of the 100,000 ft of piping extending throughout the Shippingport plant is contained in this cylindrical chamber. It is made of steel encased in a 5-ft-thick concrete "box," has a diameter of 50 ft, and is 147 ft long.

How preliminary testing was organized and carried out, before the Shippingport Atomic Power Plant went critical. There are four phases to the program: Inspection and checking; precritical system testing; initial critical testing; and initial power operation. This paper discusses only the first two.

SHIPPINGPORT—Preliminary Testing

By E. M. Parrish, Mem. ASME

General Superintendent,
Power Stations Department,
Duquesne Light Company,
Pittsburgh, Pa.

PRELIMINARY testing at Shippingport, Pa., began Dec. 1, 1956, with a check of the 138-kv switchyard and the 2400-volt station service transformers and buses. It concluded when the station demonstrated its ability to carry load successfully without pending construction adjustment. Preliminary testing was in four phases:

1 The first phase, inspection and checking of equipment, insured that the equipment had been installed properly and could be operated safely.

2 The second phase, precritical system testing, determined that the various systems upon which the core is dependent will operate in accordance with design, checked the integrity of the systems and equipment, and provided valuable operational data.

Contributed by the Power Division and presented at a joint session of the Power and Nuclear Engineering Divisions at the Semi-Annual Meeting, San Francisco, Calif., June 9–13, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 57—SA-55, originally entitled "Preliminary Operation—Shippingport Atomic Power Station."

3 The third phase, initial critical testing, determined that the reactor core could be operated safely, and provided the necessary data to prove the various core calculations.

4 The fourth phase, initial power operation, determined that the station was capable of carrying load.

This paper is confined to the first two phases.

Responsibilities

The responsibilities for preliminary testing were identical to those for the design and erection of the station:

1 The Atomic Energy Commission, with the Atomic Power Division of the Westinghouse Electric Corporation acting as agent, was primarily responsible for all checking and testing in the reactor plant. They ascertained that the equipment was installed properly and that the test and check-out procedures followed during this period were safe and proper.

2 The Duquesne Light Company's Engineering and Construction Division had the same responsibility in regard to turbine-generator plant equipment.

3 The Duquesne Light Company's Power Stations Department was responsible for providing trained start-up crews and test personnel for the entire station. They formulated all operating and testing procedures, and in conjunction with the design and construction groups, both Westinghouse and Duquesne Light determined before operation began that the equipment was installed properly and was safe to operate. The personnel assigned to the start-up crew and the test organization were those who were also charged with the operation and testing of the station after start-up.

4 The representatives of the various equipment suppliers bore the same responsibility as their counterparts in any new power station. Working with the start-up crew and the design and construction groups, they determined that the equipment was properly installed and gave aid and assistance in checking the equipment.

Phase I—Initial Inspections and Checks

The actual work performed during the first phase consisted of two separate types. The first, performed by the construction groups and observed by the operating personnel, consisted of inspections and checks to insure proper and complete installation. These included such items as clearance checks, lubrication check, valve and circuit-breaker operational checks, meggering, phase checking and control, relay, and instrument calibration. The operating crew performed the remaining work during this phase under the observation of the construction groups. This work consisted of bus energizing, motor rotation, leak tests, and trial operations. Each item of equipment in the station was checked individually. The more important the equipment, the more extensive the checking.

Phase I work was performed, for the most part, on an informal basis from a test standpoint; however, a rigorously controlled procedure was followed to insure equipment and personnel safety. This procedure consisted of two parts: A clearance routine was designed to promote personnel safety; test open disconnects, circuit breakers, and closed valves which prevent operation or energizing, and any other equipment which possibly could be connected to the equipment or system about to be operated.

A start-up sheet consisted of a check-off list for the safety of each system to be checked before energizing, and a continuing record of the status of the work.

No unit or system could be energized or operated until the start-up sheet and clearance routine had been properly completed. Any deficiencies which materialized were corrected before proceeding with Phase II.

Phase II—Precritical Systems Testing

The tests performed during this phase were of three types: equipment-acceptance tests, system-performance tests, and system-operation tests. The first type of test, which included such items as pump performance, heat-exchanger performance, and similar tests, determined that the various units of equipment met the manufacturer's guarantee; the second determined that the various units of equipment comprising a system operated as designed; and the third provided information such as system response times, and so on, from which operating techniques could be developed. The latter type of test also provided information on equipment reliability.

The extent to which the station could be tested during the second phase was quite extensive. Essentially, the only turbine-generator plant items which could not be checked completely were those requiring steam for turbine operation such as the turbine-generator proper, the condensate system, and the boiler-feed system. The reactor plant could be tested almost in its entirety. A device which simulated the pressure drop of the core was placed in the reactor vessel to permit operation of the coolant pumps. By utilizing the pressurizer heaters and the heat loss of the reactor-coolant pumps, it was possible to raise the reactor coolant and associated systems to rated temperature and pressure, thus permitting many aspects of power operation to be simulated. With these systems at operating conditions, it was also possible to test the reactor plant auxiliary systems under conditions approaching actual operation. During this period, final adjustments were made to the various instrument and control systems.

The testing during this phase was handled on a formal basis with test procedures specially prepared by the station test personnel, in accordance with test descriptions prepared by the respective design organizations responsible for preliminary testing. In a few instances where special procedures were not provided, ASME test codes were used. The handling of a specific test

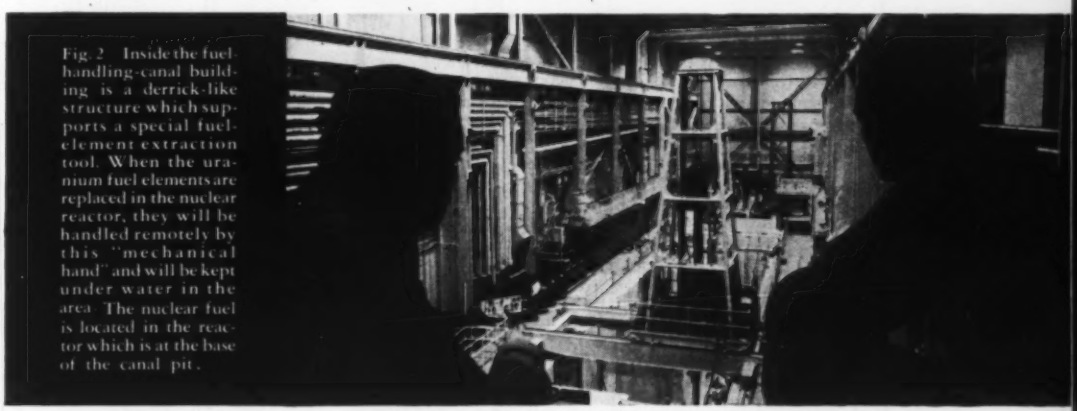


Fig. 2 Inside the fuel-handling-canal building is a derrick-like structure which supports a special fuel-element extraction tool. When the uranium fuel elements are replaced in the nuclear reactor, they will be handled remotely by this "mechanical hand" and will be kept under water in the area. The nuclear fuel is located in the reactor which is at the base of the canal pit.

Fig. 3 A white-garbed atomic-power technician makes final check on the instrumentation apparatus atop the head of the nuclear reactor. The tubing contains instrumentation which feeds information from the reactor to the control room where readings are recorded automatically on numerous charts and gages.

from test description to test report consisted of the following steps: (*a*) Inspection and checking of equipment as installed; (*b*) precritical system testing; (*c*) initial critical testing; (*d*) initial power operation. A reactor plant test is used as an example. Essentially, the same procedure applied for turbine-generator plant tests.

Testing Program Procedure

1 A test description prepared by the Westinghouse Atomic Power Division stated the purpose of the test, the prerequisite equipment, the station conditions required for the test, the information desired, and, in some instances, the predicted results.

2 The test procedure prepared from this listed the operations required to meet the test conditions in detail, the operations required during the test, the data to be taken, the necessary data sheets, and the frequency of tabulation.

3 The test procedures were forwarded to Westinghouse for review and comment. The procedure with comments was then reviewed by the joint test group, described later, which had final approval.

4 The test was performed by the test organization with Westinghouse and Atomic Energy Commission personnel and the joint test group observing when necessary.

5 The test results were compiled by the test organization and were forwarded to the joint test group which performed a preliminary evaluation. This evaluation consisted of a review of the test results to determine that they were valid and constituted a successful completion of the test as described in the test description.

6 The joint test group then forwarded the test results and the preliminary evaluation to the Westinghouse design group where a final evaluation was made, if deemed necessary.

7 After the final evaluation was made, the station test organization prepared a test report if justified by the results of the test.

Joint Test Group

The joint test group was a co-ordinating organization formed in June, 1956, with representatives of all groups involved in the testing. The construction group representation was withdrawn as the work progressed. In addition to the review, approval, and evaluation duties, the group was charged with the task of preparing and administering the over-all testing schedule, and insuring that the shift from construction to operation was accomplished as smoothly as possible.

Outline of a Typical Phase II Test

The details of testing are best shown by a description of the reactor-component cooling-water system test which was chosen, since many conventional stations are provided with a similar system.

The system, shown schematically in Fig. 1, consists of an expansion tank, two component cooling-water pumps, a cooler, piping, and the necessary instrumentation and controls such as thermometers, pressure gages, flowmeters, and flow-control valves. The piping system consists of a supply header, a return header, and connections from the components receiving cooling water to the supply and return headers. The system services two nonregenerative heat exchangers in the coolant-purification system, four main coolant pumps, the air compressor in the valve-operating system, the neutron shield tank, the thirty-two control-rod drive motors, the coolers in the failed-element-detection-and-location system, and six canned-type motor pumps used as discharge pumps for the flash and blowoff tanks and as recirculation pumps for the failed-element-detection-and-location system. The heat absorbed from the components is transferred to river water from the turbo-generator circulating-water system in the coolers.

This system was chosen as being typical of many others and covers many of the items common to them. As is the case with all of the systems tests, this test was performed to prove the integrity of the entire system and to test the individual components in order to assure that the operation was as designed. The test of this system was divided into four sections, each section intended to cover one phase of the complete test.

In the first section, the expansion tank, component cooling-water pumps, cooler, and supply and return headers were completely filled with water and hydrostatically tested, using a hand pump. At the same time, the pressure was increased in order to test and set the relief valves. The level indicator and alarms on the expansion tank were tested and adjusted as necessary to provide for satisfactory operation. During the test, data were observed and recorded, including the hydrostatic test pressure, comments on the location of any leaks and the repairs made, the relieving pressure of the relief valves, and the high and low-level-alarm set points for the expansion tank.

In the second section of the test, corrosion inhibitor was added to and thoroughly mixed with the system

water. Following the initial addition of this inhibitor, the concentration was determined weekly for a 2-month period. Any change in the concentration of this inhibitor indicated a plating action, and the concentration was then re-established by the addition of inhibitor to the system.

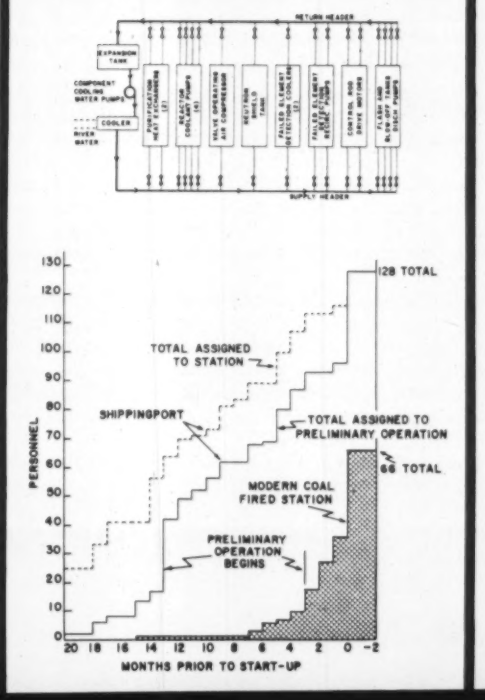
As each of the components in this system was installed, the piping loop from the supply header through the component to the return header was filled and hydrostatically tested as a part of the third section of the test. Included with the hydrostatic test was a test of any relief valves in the loop. Also, as a part of this section, the instrumentation and controls were observed for satisfactory operation, performance tests were made of the component cooling-water pumps, and when all the individual cooling loops through the various components were complete, the flow through the individual components was adjusted to a predetermined value by setting the flow-control valves in all loops. The data recorded for this section of the test included the same items recorded in the first section, such as hydrostatic test pressure, comments on the location of leaks and repairs made, relief-valve settings; in addition to these items, the head and capacity information for the component cooling-water pumps and the flow rate through each component loop were recorded.

In the fourth and final section of the test, the cooling-water conditions for each component served by the system, operating under normal plant conditions, were determined. During this section of the test the entire system was observed as a single unit and a heat balance obtained for the cooler. The data recorded included cooling-water pressure, temperature, and flow to each component and the component temperature. The river-water temperature and pressure, and the component cooling-water temperature and pressure entering and leaving the cooler also were recorded.

The completion of these four sections of this one test established the satisfactory operation of the system. In a conventional power station by way of comparison, many of the same tests are made but on a less formalized basis. Normally, in the conventional power station, the system would be placed in service initially by the operators who would observe, generally, the cooling-water flow, temperatures, and pressures, and would assure themselves that the system is operating satisfactorily. In most cases, no further test would be conducted unless there was some evidence of system malfunction.

Fig. 4 *Top:* The component cooling-water system of the Shippingport nuclear power station

Fig. 5 *Bottom:* A comparison of the personnel required for preliminary testing of Shippingport and for a conventional station



Staffing

The magnitude of the preliminary operating program at Shippingport, as compared to that of a conventional station, is reflected in the number of personnel involved prior to start-up. This is illustrated graphically in Fig. 5 which presents a comparison of the personnel assigned to a conventional station of the Duquesne Light Company and those assigned to the Shippingport Station at various intervals prior to start-up.

The preparation for the preliminary operation of Shippingport began approximately 20 months prior to start-up when two men, as shown by the solid line, began the preparation of test descriptions for the turbine-generator plant. This group was increased to eight men during the next three months when the preparation of test procedures began. The first personnel were assigned to the station proper 15 months prior to start-up, and during the thirteenth month, when preliminary operation actually began, the group was increased to 42 men including the station guards. During the preliminary operating period, the group was increased to the station total of 128 persons. The cross-hatched section represents a similar period during the start-up of a conventional station. The difference between the solid and broken lines represents the personnel involved in training programs during this period.

The contribution of the personnel of the Atomic Energy Commission, the Westinghouse Atomic Power Division, the various equipment suppliers, and the construction forces during testing is not shown by this presentation. These groups aided and continue to aid tremendously in the work. The Atomic Energy Commission and Westinghouse assigned personnel full time to the station to observe and assist in the start-up.

Summary

The magnitude of testing during Phases I and II of preliminary operation was dictated by several factors. The one of major importance was the desire to learn as much as possible about the reactor plant prior to inserting the reactor core. Since the equipment, although similar to that in other installations, had not had previous application in power-station work, it was necessary to extract all possible information from the plant in order that the core could be inserted with definite assurance that the operation of the various systems could be performed safely and satisfactorily. In line with this requirement, it also was necessary to familiarize the operator thoroughly with the various systems and their operation.

We begin our careers as "specialists" in a particular line of work, but soon assume some of the responsibilities of management. With this change there must be a growth in attitudes and objectives. While many of its skills can be learned, management is a way of life based on inner convictions, a concept of service, and a genuine appreciation of those with whom we work.

The Job of the SPECIALIST in MANAGEMENT

By Carl A. Beck, President,

Charles Beck Machine Corporation,
King of Prussia, Pa.

AT SOME TIME each of us is called on to make a transition from worker to manager. Rare indeed today is the man who graduates from college and successfully works himself from the top down. Our first job, whatever it may have been, was to fill a particular niche, do a specific task or job. We were specialists if for no other reason than because we were not expert in everything. But if we expect to grow in stature—in value to society, or to ourselves or our family—we must broaden our horizons. We must learn to work well with people. And as these people become those for whose work we are held accountable, we must begin to be less the "specialist" and more a "generalist."

Many companies, or divisions, or even departments are "sales-oriented," or "production-minded," or "design-conscious." Invariably this is because the top man was, himself, formerly sales-manager, production vice-president, or inventor, or chief engineer. Consequently, the whole organization is slanted toward that specialty. It is an evidence of reluctance to let go of the reins of a former job, a resistance to admitting that someone else can do the job just as well.

To those who find it difficult to delegate responsibility and authority for the job which was formerly their specialty, Lawrence Appley once said that a person who can devote full time to a job can do it better than another, who may be more competent, but who can only devote part time to it. It is often necessary, particularly in a small organization, for people to wear many hats. But, be sure to take off your specialist's hat while the manager's hat is on. No one looks so ridiculous as he who tries to wear two hats at the same time.

Management Is a Profession

Anyone who is responsible for getting things done through the efforts of others is a "manager," whether the job is a line responsibility in a staff department or that of a staff specialist. There is only one basic difference between line and staff functions: The line says, "Do it"; the staff says, "*When* you do it, do it this way." And if management is truly the art of getting things done through people, then sometimes the staff man must be a much better manager than the line executive.

Management is a science. It has proven formulas and accepted procedures. Like other professions, it has its codes of ethics, a fund of experience, and a set of tools. It requires study to become and remain a successful manager. And like other professions, it requires skills—skills which can be learned, skills which can identify successful managers. But it is also an art, because it involves working with people, and human relations will never be reduced to an exact science. What we can learn, however, is to use a systematic and orderly approach to human relations problems. We can learn to utilize the tools of management; that is, forecasts, plans, budgets, standards, organization structure, audits, incentives, controls, and many others. We can learn the skills of management; such as, selecting people, materials, equipment; or reviewing and appraising, decision-making, planning, organizing, co-ordinating, and so on. These things may help us to "get ahead," but which direction is forward?

Objective

Have you ever asked yourself: Why are you in business? Why are you holding the job you now have? Where do you want to be five, ten, twenty years from now? What are your personal long-range objectives? You can't think about such things very long or seriously before you are faced with some pretty broad problems: Why are we here? Why this little ball of sod called "earth"? And then maybe you admit a "great unknowable," the existence of some supreme being—call him what you will. My own personal philosophy of life won't be inflicted on you, but let me remind you that a philosophy of life must precede your business philosophy. On such foundations are built company creeds and management creeds.

Once you have a broad over-all objective, how do you get there? You must begin to formulate some shorter-

Contributed by the Management Division and presented at the Annual Meeting, New York, N. Y., Dec. 1–6, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from Paper No. 57—A-252.

range, more concrete objectives as a means of reaching the longer-range ones. If it is an organization we're talking about, what are its purposes? What does it do or make? What is its product or service? Whom should it serve? What service should it render? Such questions could be asked by a division vice-president, department manager, or section chief, as well as by a company president. Only when our purpose, our objectives, are clearly defined—and set down in writing—are we really prepared to plan and to organize to reach these objectives. In any undertaking, no matter how large or how small, it is folly to try to go somewhere before you know where you want to go.

This is the basis for policy, and the line of demarcation between objectives and policies is admittedly very vague. But you must come to some determination as to what you want for your share of the market, or do you really want the jobs of your employees to have meaning and dignity? What is your stand on labor relations, as well as on employee relations? What should be your policy on participation in community endeavors, by yourself and by your employees?

Participation

If the word "objective" could be called the first key to good management, the second should be "participation." It may be participation in setting an objective, or assistance in planning action, or in determining policy or procedure. Underlying this concept of participation is the realization that people like to belong—they want to have a voice in those matters affecting them. If you have ever experienced a "brainstorming" session you know that two or more people together can create more than the sum of their individual thoughts. Participation is what Herbert Carey some years ago, aptly named "consultative supervision." The man doing the job probably knows more about the job, how it should be done, and how it is being done, than anyone else—because he's *doing* it! Yet, how often do we consult with him in making decisions about *his* job?

You may be thinking: "That's for the boss, not me!" But, if your beliefs and philosophy are not in accord with your company's management creed, then both you and the organization will suffer as long as such conflict exists. To his men, the foreman is the "president" of the company. He is the man who sets the tone of the department, interprets company policy, and is the first line of company communication. The way he treats his subordinates, the way he implements company policy, sets the personality of the company and determines how the entire organization is judged. If the foreman has had a voice in making policy, the employees' concept of the company may be valid. If his opinions differ from top management's, there is an automatic block to communication.

One of the most valuable by-products of participation is the ready acceptance of a plan or decision by those who participated in creating it. Even when a decision may be contrary to our own convictions, we accept it more readily if we know our opinions were heard and adequately considered. Real participation sets company climate in which people can grow and develop.

Communication

The third key word in management is "Communication." Communication is not only what we say or write. It's what we do—or don't do. It's the way we talk, the way we walk, the way we look, or the way we shake hands! It may be the raising of an eyebrow, or an impatient tapping of the foot.

A man who is a manager, or any kind of a supervisor, is under constant surveillance. He must be aware of his aspect, since he is always communicating to his subordinates, his superiors, and to all those about him—whether he wants to or not! Frequently the written or spoken communication must be so lucid that it counteracts erroneous impressions conveyed by some other means. Yet if our creed, our philosophy, and our convictions are sound and sincere, so also will be our actions.

Good communication may or may not be a science, but it is most assuredly an art and a skill. It is the life blood of any organization. It is management's most important tool, because it motivates people to do their job, to make their own contribution.

Little of what has been stated can be called novel or original, except possibly the check list of key words of good management—objective, participation, communication. And yet as we grow aware of our management responsibilities, of our obligation to encourage the development of those under us to their fullest potential, we know that management is not a "gimmick" or check list. Management is a way of life. It is based on well thought-out philosophies and inner convictions. It must embody the concept of service, on our own part as well as in our subordinates. Above all, a manager must have humility, whatever other qualifications he may possess.

Conclusion

In the past two decades, the job of management has undergone a striking change in concept. Today's successful manager is a professional man. Management has its code of ethics, its scientific approach, its own tools and formulas, its skills which can be learned and developed. It requires skill because it is the art of working with people, of motivating people to maximize their contribution to the common goal through the development of themselves and the people under them. Like any profession, successful management requires continuous study. What was once "by guess and by gosh" management by the "seat-of-the-pants" has given way to the systematic and orderly approach.

Today the successful specialist no longer locks himself in his ivory tower. His value instead is judged by his ability to get things done. As he grows in stature and competence, he must lean more heavily on those about him, and in turn be ready to give them his counsel and assistance. The job today is too big for him to do alone. He must get the job done through other people. He must broaden his horizons beyond his own specialty, and begin to learn the tools, the skills, and the art of the management profession. He becomes acutely aware of the potentials of those for whose work he is held accountable, and he begins to realize that only by *their* progress and growth are his own responsibilities being met

In short, he comes to learn that, truly: Management is *not* the direction of things—It *is* the development of people!

The Job of the SPECIALIST in MANAGEMENT

HIGH-PRESSURE

Based on three papers contributed by the Petroleum Division and presented at the Petroleum Mechanical Engineering Conference of Tulsa, Okla., September 22–25, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Fig. 1 The 15,000-psi-working-pressure Christmas tree

Control of 15,000-Psi Well

THE number of deep wells drilled by the petroleum industry each year has been increasing, and new depth records are being established nearly every year. The first well was drilled below 10,000 ft in 1931. By 1956, 2635 wells were drilled below that depth and a record of 22,570 ft had been reached. It has been predicted[2] that the number of wells 16,000 ft and deeper, to be drilled during the next decade in the California and Gulf Coast regions, will increase from about 70 to about 330 a year.

Experience has shown that the deeper the drilling, the higher the bottom-hole pressure will be. In the Gulf Coast area, deeper wells also frequently encounter so-called abnormal-pressure formations, with the degree of abnormality increasing with depth. Wells being drilled below 12,000 to 14,000 ft in areas where maximum abnormal bottom-hole pressures are likely to be present may be completed with surface pressures exceeding 10,000 psi. As a consequence, it seems logical to conclude that the need for 15,000-psi equipment will increase with deeper drilling.

[1] By C. A. Dunlop and T. V. Miller, Humble Oil & Refining Company, Houston, Texas. Condensed from ASME Paper No. 57—Pet-25.

[2] C. E. Reistle, Jr., in a talk before a local section meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers, stated as to the probability of production at great depths, that good porosity below 20,000 ft has already been proved and there seems to be no good reason why it should not continue below this level.

Experimental Development

IN THE experimental development work leading to the issuance of the American Association of Well Head Equipment Manufacturers' Standard No. 6, "AWHEM Specification for Ring-Joint Flanges for Drilling and Production Service for 15,000-Psi Working Pressure," a preliminary effort by the Design Group resulted in flanged connections that were completely out of reason in size and weight. Since these design procedures were taken from a standard work,[6] the Standardization Committee decided that a closer investigation of design factors was warranted. As a preliminary to actual design the first phase of the experimental work was initiated.

[5] By R. C. Brooks, past chairman, Standardization Committee, Association of Well Head Equipment Manufacturers; manager of engineering, Cameron Iron Works, Inc., Houston, Texas. Mem. ASME. Condensed from ASME Paper No. 57—Pet-8.

[6] "Development of General Formulas for Bolted Flanges," by Waters, Rossheim, Wesstrom, and Williams. These formulas, rearranged for easier computation, are used in the "1956 ASME Unfired Pressure Vessel Code."

WELLHEAD EQUIPMENT .... *is needed for operation with the great depths encountered in drilling modern oil wells. New flange standards, special closures, and improved gaskets resulted from the experimental work of a task group of the Association of Well Head Equipment Manufacturers.*

Pressures[1]

The development of deep abnormal-pressure reservoirs has not been possible until recently, chiefly because of the lack of availability of proper wellhead equipment, valves, and tubular goods. These inadequacies were brought out forcibly early in 1952 upon completion of a 14,000-ft Louisiana gas-condensate well which had a bottom-hole pressure of 12,100 psi and a shut-in surface pressure of 10,000 psi. The well was drilled with 17.7-lb per gal mud, and drill-stem tested prior to completion.

At this time, the industry had standards covering Christmas-tree valves, Fig. 1, and flanged connections only for 10,000-psi working pressure. Tubular goods were available on special order from specialty mills for working pressures approximating 10,000 psi, and no satisfactory tubular connection from the standpoint of pressure seal had been developed for pressures of the order of 15,000 psi.

The need for better and higher pressure testing, as well as for wellhead flanges, valves, and tubular goods that would withstand and seal 15,000-psi working pressures was also apparent. A flange differing in sealing principle from the API ring joint would be necessary, and was already being developed by one manufacturer. The Association of Well Head Equipment Manufacturers proceeded to develop their connection, as presented in the companion papers. The specification developed for 15,000-psi flanges was presented to API and is now in the process of being adopted as tentative Standard 6B-X, the Industry-wide standard for extreme-pressure service.

Many steel companies have developed quenched-and-tempered casing having minimum yield strengths of 140,000 to 150,000 psi, yet having ductile properties comparable to API Grade N-80.[3]

Material used in the 15,000-psi working-pressure tubing head, valves, and flanges has a 75,000-psi min yield strength, and 90,000-psi min ultimate strength with 18 per cent elongation and 30 per cent reduction of area.[4] It is of extreme interest to note that the flange seal that was selected for use in the assembly has a safety factor of slightly better than 3 to 1 on minimum yield strength at working pressure. This is indicated by the extensive stress analysis discussed in companion papers.

[3] "High-Strength Tubular Products for Deep Drilling," J. J. Lenker and H. W. Heckathorne, was presented at the Spring Meeting of the American Petroleum Institute Southwestern District, March, 1957. The API, recognizing the importance of high-yield-strength tubular goods, is preparing a tentative specification, 5A-X, for casing and tubing having minimum yield strengths of 105,000 psi and greater.

[4] The authors wish to extend sincere thanks to their many associates in Humble Oil & Refining Company who were of assistance in securing data. They also make acknowledgment to the management of the Company for permission to prepare and present this paper.

Work With 15,000-Psi Wellhead Connections[5]

Tests Undertaken

Bolt-torque versus leak-pressure tests were undertaken using 4-in. API 10,000-psi working-pressure flanges to determine the relationship between bolting make-up and pressure resulting in the leak of the gasket. These tests verified the fact that there is a direct relationship between bolting torque and leakage pressure; that the point of seal is neither on the OD nor the ID of the gasket, but somewhere between; and that the location of the seal is not necessarily consistent. It was a further conclusion that the committee should test the largest of the 10,000-psi working-pressure flanges, the 10-in. × 7-in. API flange.

Bolt elongation versus pressure tests, Fig. 2, determined the action of large-size stud bolts (2-in. diam) under load-

Fig. 2 Measuring bolt elongation due to pressure

HIGH-PRESSURE WELLHEAD EQUIPMENT

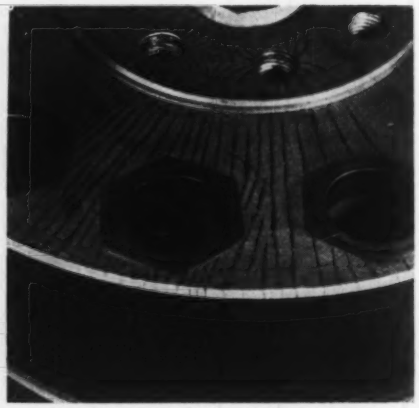


Fig. 3 Stresscoat patterns marked with crayon indicate the over-all patterns of major stress

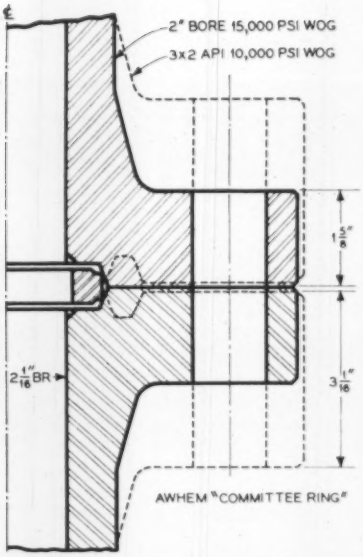


Fig. 4 The "Committee Ring" developed by the Association of Well Head Equipment Manufacturers

ing conditions introduced by hydrostatic pressure. At 25,000 psi, the total bolt elongation averaged 0.021 in., roughly the equivalent of only 48,000-psi tension in the 2-in. bolt.

It was concluded that, under test conditions, total bolt elongation, and therefore stress of the bolts, is directly proportional to the hydrostatic pressure load. Further experimental stress analysis of this connection was conducted in order to establish experimentally the actual safety factors inherent in this connection.

The brittle-coated method, Stresscoat, was used to approximate the actual stresses existing in a 10-in. API 10,000-psi working-pressure flange connection under pressure-loading conditions. Making correction for true strain, and projecting all stress levels to that of the 25,000-psi load, on the assumption that stresses are proportional to hydrostatic load, the maximum stress was equivalent to 58,000 psi. Considering the fact that the flange was pressured to $2^1/_2$ times its rated working pressure, the actual stresses were of a very low level and indicative of the tremendous safety factor inherent in the flanges designed by the API-ASME Code. In Fig. 3, the Stresscoat pattern has been traced with a black crayon to show more effectively the over-all pattern of major stresses.

The conclusion was that both the actual bolting stresses and actual flange stresses are far lower than are necessary for a satisfactory safety factor.

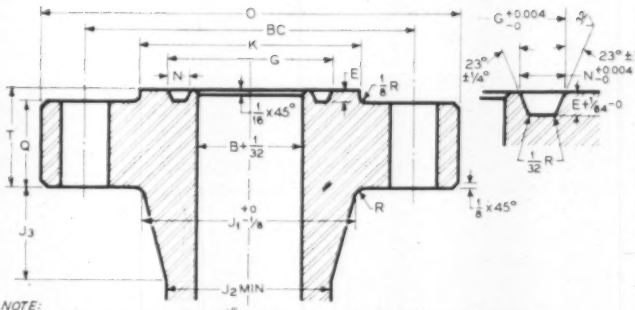
Tests were conducted to investigate the phenomenon of the bolting make-up versus leakage pressure for the 10-in. flange to correlate with similar information developed for the 4-in, 10,000-psi flange. The flange held 8000, 11,000, and 23,000 psi in successive tests without leakage. With no O-ring inside the API R-91 ring gasket, it appeared that the metal ring gasket was acting as a pressure-energizing seal. A plot of total bolt elongation versus hydrostatic pressure demonstrated that, contrary to anticipated results and contrary to the results of the test of the 4-in. API 10,000-psi flange, it was shown that bolt loading is not a function of leakage pressure, but is a function of hydrostatic pressure; and that the bolting load, as indicated by elongation, varies proportionately to the hydrostatic-pressure load.

Substitution of a stainless-steel API ring gasket, R-91, in place of the soft-iron gasket, proved conclusively that it was not sealing at all on the ID, except possibly at the lower pressure level. A thorough and detailed analysis of the angles of the grooves of both flanges, and the angles of the ring with the pitch diameters of the groove and the ring superimposed showed angular mismatch.

Other types of gaskets were tested in this same basic flange to see if they would function in the same way. It became obvious that the API R-50 octagonal ring gasket was being crushed between the two flanges, and was not capable of carrying the bolting preload. Considerable galling between the nuts and the flange face finally precluded any further tightening of the stud nuts. This effectively demonstrated the impracticability of field tightening flange connections of this type to stop a leak at 12,000 to 15,000 psi.

Calculations showed 21,000 psi to be the minimum bearing pressure at which a soft-iron metal ring gasket will maintain a seal against the groove. It was estimated that the soft-iron ring gasket withstood over 100,000 psi without further crushing.

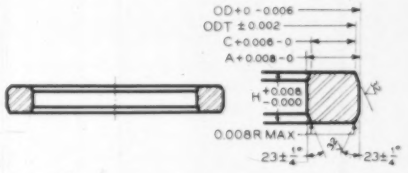
Restudy of the R-50 octagonal ring gasket, which had completely failed to be pressure-energizing, showed that it originally had a pressure-contact ratio of 1.625. Modification by undercutting changed the pressure-contact ratio to 3.25. The ring was then tested to 30,000 psi without leakage. The bolt elongation versus hydrostatic pressure proved again that the ring was now fully pressure-energizing and sealing on the OD in a manner almost identical to that of the theoretical curve.



NOTE:
BOLT HOLES SHALL BE DRILLED 1/8" LARGER IN DIAMETER THAN THE BOLT SIZE

Fig. 5 *Left*, AWHEM flanges for the 15,000-psi wellhead equipment

Fig. 6 *Below*, AWHEM gaskets for the 15,000-psi wellhead equipment



NOTE:
ALL FINISHES 120 RMS MAXIMUM EXCEPT AS NOTED

BASIC FLANGE DIMENSIONS								BOLTING DIMENSIONS				FACING & GROOVE DIMENSIONS			
NOMINAL SIZE & BORE B	OUTSIDE DIAMETER O	TOTAL THICKNESS T	BASIC THICKNESS Q	LARGE DIA OF HUB J_1	SMALL DIA OF HUB J_2	LENGTH OF HUB J_3	RADIUS AT HUB & FLANGE R	DIAMETER OF BOLT CIRCLE BC	NUMBER OF BOLTS	DIAMETER OF BOLTS D_1	LENGTH OF BOLTS L	DIAMETER OF FACE K	OUTSIDE DIA OF GROOVE G	WIDTH OF GROOVE N	DEPTH OF GROOVE E
1 1/16	7 3/8	1 11/16	1 1/2	3 11/16	2 11/16	1 7/8	3/8	6	8	3/4	5 3/4	3 5/8	2.893	0.450	7/32
1 13/16	8 3/16	1 15/16	1 3/4	3 27/32	2 13/16	1 7/8	3/8	6 5/16	8	7/8	5 3/4	3 7/8	3.062	0.466	7/32
2 1/16	8 3/4	2	1 3/4	4 3/8	3 1/16	2 1/8	3/8	6 3/4	8	7/8	6 1/4	4 1/2	3.395	0.4975	17/64
2 9/16	10	2 1/4	2	5 1/16	3 15/16	2 1/4	3/8	7 7/8	8	1	7	5 1/4	4.046	0.554	11/64
3 1/16	11 5/16	2 17/32	2 1/4	6 1/16	4 13/16	2 1/2	3/8	9 1/16	8	1 1/8	8	6 1/16	4.685	0.606	19/64
7 1/16	19 7/8	4 11/16	4 1/4	12 12/16	10 7/8	3 5/8	5/8	16 7/8	16	1 1/2	13	12	9.521	0.9206	7/16

BASIC GASKET DIMENSIONS					
SIZE BORE OF FLANGE B	OUTSIDE DIAMETER OD	HEIGHT H	WIDTH A	FACE DIAMETER ODT	FACE WIDTH C
1 1/16	2.842	0.366	0.366	2.790	0.314
1 13/16	3.008	0.379	0.379	2.954	0.325
2 1/16	3.334	0.403	0.403	3.277	0.346
2 9/16	3.974	0.448	0.448	3.910	0.385
3 1/16	4.600	0.488	0.488	4.531	0.419
7 1/16	9.367	0.733	0.733	9.263	0.629

It followed that the inherent ability of a ring gasket to be energized by pressure is controllable by design, and the pressure-contact ratio must be such that pressure can take over when the initial flange make-up is not sufficient to hold the pressure load.

Theoretically then, the gasket surfaces must be initially preloaded to insure an initial seal. Thereafter, when pressure is applied to the connection, and flange movement occurs, the product of the total pressure times the contact ratio of the gasket must at all times exceed 21,000 psi in bearing. If these conditions are met, the ring gasket should continue to hold pressure. It must be understood that these conditions apply for the soft-iron ring gasket, and a stainless-steel ring gasket might require something in the order of 30,000-psi bearing load in order to maintain a pressure seal.

The tremendous amount of flange movement raised the question as to how much actual movement was taking place in the ring-groove area. Testing indicated that the amount of flange movement taking place in the ring-gasket area (amounting to 0.058 in.) gave further conclusive evidence that the ring gasket is pressure-energizing, since no other type of gasket can contain pressure under such conditions.

Another question was the effectiveness of the groove angle. Several modifications were made and tested. An important conclusion was that surface finish can be a contributing factor to leakage or failure of the pressure seal, but the surface finish in itself cannot effectively correct a leak or make a tight seal if the pressure-contact ratio is not adequate for the operating conditions. The original pressure-contact ratio of 1.83 enabled an experimental $12^1/_2$ deg ring gasket to contain the pressure from "blowing by," but could not provide or maintain a completely pressuretight seal, whereas a pressure-contact ratio of 3.67 provided a perfect seal at all pressures.

Another test was conducted immediately following to cycle the hydrostatic pressure from zero to 15,000 psi. This was done for 50 cycles without leakage and with no apparent wear or distress of the ring or groove. The test caused the committee to arrive temporarily at an erroneous conclusion that flange breathing of the connection under cycling pressure conditions would cause no damage.

The Committee Ring

The results of these tests led to the development of the so-called Committee Ring, Fig. 4, which was designed on the basis of a pressure-contact ratio of 3 to 1 and was located adjacent to the bore of the flange connection. Since the ring gasket cannot take any direct mechanical load in an axial direction, the flanges were allowed to butt face to face, providing a very rigid mechanical structure as well as a pressure-holding connection. Also, having the ring gasket located adjacent to the bore reduces the pressure area and the resulting pressure load. With this ring gasket the committee was able to design the smallest flange connection of those studied. The complete family of connections was designed, and the 2-in-bore and the 7-in-bore connections were thoroughly tested. High-pressure gas testing with bottled nitrogen was initiated to verify further some of the results obtained by hydrostatic tests.

A 7-in-bore connection utilizing the Committee Ring was initially hydrostatically tested with 22,500 psi, with the flange bolts tightened to 500 ft-lb. The connection was then hydrostatically cycled from zero to 20,000 psi 19 times with no leakage. After such testing, the flanges were reassembled with a new stainless-steel Committee Ring, and tested with dry nitrogen gas. Preliminary gas testing showed minor leakage, even though hydrostatic tests had been completely satisfactory. The reverse procedure was followed in testing a $2^1/_{16}$-in-bore

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connection utilizing the Committee Ring where minor gas leakage (0 to 100 cc per min) was encountered at 15,000 psi, whereas succeeding hydrostatic tests to 15,000 psi indicated no leakage whatsoever. Tests of these two connections finally pointed to the conclusion that the sealing surfaces of the ring and groove should be on the order of 10 microin. rms for an absolutely gastight seal.

Final Design and Proof Testing

Following tests, the design subcommittee developed a new family of connections for the 15,000-psi working pressure. It was decided to incorporate the 23-deg angle groove in this design, and to have the flanges butt face to face in their fully made-up condition. The final flange design is illustrated in Fig. 5, and the final ring gasket in Fig. 6.

At the request of members of API, the final wellhead connection in the 7-in-bore and 2-in-bore sizes were manufactured by AWHEM and independently stress-analyzed by a testing laboratory. The results have been published as AWHEM Bulletin No. 6A.

In neither flange did the total maximum stress at an internal pressure of 22,500 psi exceed 35,740 psi stress at any point where measurements were taken on the exterior surface of the flanges. This reveals an indicated safety factor at these points of at least 2, when compared to the minimum yield strength of 75,000 psi for the material. This is also indicative of the conservatism of the design approach, since theoretically the safety factor of 2 should have been reached at a working pressure of 15,000 psi rather than 22,500. Furthermore, the stresses due to

Design Considerations for

In addition to providing the engineer with the necessary information for the design of high-pressure flanges and gaskets for 15,000-psi applications, the design is useful also in extending the present 10,000-psi API group of flanges to larger sizes, as required.

The Pressure-Energized Gasket

In ASA and API flanges, the gasket separates the flanges. Therefore it must be strong enough to take the full bolt load when the bolts are tightened and no pressure exists in the flanges. The bolt load in the ASA flanges consists of the load caused by pressure trying to separate the flanges plus the load necessary to keep the gasket tight, which load is assumed to be a multiple of the unit pressure, exerted on the projected seating area of the gasket. A vicious circle is established thereby: The greater the bolt load, the greater the gasket width and seating area necessary to support it, in turn necessitating an increase in bolt load. Enormous gaskets and bolts can be designed this way.

After series of tests, a way was found to circumvent this situation. If the flanges are made up face to face, this arrangement will support the bolt load when no pressure is in the flanges; and if the gasket is pressure-energized, only a small initial load is necessary to establish sealing. Therefore the bolts have to carry only the pressure load plus any small axial component of the gasket contact pressure. Thus the gasket cross section becomes independent of the bolt load.

When the bolt load is carried by the faces of the flange at zero pressure, almost no load is carried by the flanks of the groove, and the distance from the groove ID to the bore can be made very small, thereby reducing the pressure area and again reducing the flange size.

The AWHEM Committee found that it was of no great importance which flank angle was selected, and since the users, through the API, expressed a preference for the well-established 23 deg, this angle was selected.

Experimentally, the AWHEM Committee found that a pressure-energized gasket will seal when the sealing pressure on the flanks is approximately 3 times the internal pressure on the flanges. Therefore the height of each seating surface becomes $^1/_6$ of the total height of the gasket.

The concept of pitch diameter was abandoned when stress analysis demonstrated that the gasket seals on the OD only. The gasket is now designed to be sufficiently larger on the OD to provide a stand-off of $^1/_8$ in. between flange faces when installed without bolts. On tightening the bolts, the gasket contracts until it seats on the inner flank also. The stand-off then is $^3/_{64}$ in. between flange faces. When the bolts are fully tightened and the stand-off becomes zero, the flanks of the gasket are coined slightly by the groove to insure initial seating.

As mentioned, the groove pitch diameter was originally 0.998 times the gasket pitch diameter. When the design with stand-off was made, several of those flanges had been manufactured. For this reason, it was decided to maintain the original groove dimensions and change the gasket in order to preserve interchangeability. This accounts for the factor 0.998 in the formulas. All necessary dimensions may be established from these formulas

OD of groove, $G_G = 0.998\,B + 0.9306 \times B^{1/2}$

Width of groove, $N = 0.3464 \times B^{1/2}$

OD of gasket, $G_{G1} = 0.998\,B + 0.8542 \times B^{1/2} + 0.0487$ in.

Width and height of gasket,

$$L_{G1} = 0.27 \times B^{1/2} + 0.0156$$

Materials and Stresses

The selection of material and working stresses for these flanges was made by several subcommittees of the AWHEM Standardization Committee and was based on the following considerations:

[7] By Robert Eichenberg, chief engineer, McEvoy Company, Houston, Tex.; and chairman, Design Committee, Task Group on 15,000-Psi Flanged Connections, Association of Well Head Equipment Manufacturers. Mem. ASME. Condensed from ASME Paper No. 57—Pet-23.

bolt-up condition also were considerably lower than those indicated by design formulas for bolt-up.

Additional tests allowed the committee again to conclude that the pressure-energizing seal ring is fully capable of sealing high-pressure gas to an absolute bubble-tight seal. If the flange connections are assembled and made up properly, they will effectively maintain a permanent bubble-tight seal even under cyclic conditions of temperature and pressure.

Conclusion

In June, 1957, the Association of Well Head Equipment Manufacturers published AWHEM Standard No. 6, titled "AWHEM Specification for Ring-Joint Flanges for Drilling and Production Service for 15,000-Psi Working Pressure." During the past year, some wellhead assemblies utilizing this AWHEM connection have been manufactured and put into field service.

It is felt that the Standardization Committee of AWHEM and co-operating parties have done a thorough job of investigating all factors involved in the experimental development of this 15,000-psi-working-pressure connection. All possible laboratory proofing has been accomplished, and it is with full confidence that we have proposed the use of this flange connection to the oil industry. With continued satisfactory field application and more extensive usage, the oil industry will have a new tool available for handling high pressures which will allow greater depths to be drilled in the search for gas and oil.

References

Summary Report No. 1, June 9, 1953; Summary Report No. 2, May 10, 1954; Summary Report No. 3, May 25, 1955, "Investigation of 15,000 Psi Well Head Connections," Standardization Committee, Association of American Well Head Equipment Manufacturers.

"Test Report Covering the Experimental Stress Analyses of Two High-Pressure (15,000 Psi) AWHEM Flanges," Southwest Research Institute; Bulletin No. 6A, issued by the Association of Well Head Equipment Manufacturers, June, 1957.

"AWHEM Specification for Ring-Joint Flanges for Drilling and Production Service for 15,000 Psi Working Pressure," AWHEM Standard No. 6, first edition, issued by the Association of Well Head Equipment Manufacturers, June, 1957.

AWHEM 15,000-Psi Flanges[7]

Temperature was not important since these flanges are primarily designed for wellheads and valves in oil-field service. A minimum yield point of 60,000 psi would impose a severe disadvantage in the wall thickness of the hub, and it was decided to increase the minimum yield strength to 75,000 psi, maintaining the API specified elongation of 18 per cent and the reduction of area of 30 per cent.

In order to arrive at reasonable dimensions for these flanges, higher permissible stresses were desirable, and eventually the decision was made to use one half of the minimum yield strength, both of flange and bolting material, as the permissible stress at the 15,000-psi working pressure of the flange. At the same time, the test pressure was decided to be 50 per cent over 15,000 psi, that is, 22,500 psi. Subsequent strain-gage measurements at the test pressure of 22,500 psi have shown that actual stresses are only about $^2/_3$ of the calculated stresses, probably due to the use of generous fillets at all applicable points.

Bolting material selected was Grade BC, ASTM A-354, 105,000-psi minimum yield point, the same grade as prescribed now for API flanges.

Gasket material was not changed from ASA B16.20 Standard, but a stainless-steel gasket is indicated, since wells at these high pressures are mostly gas-distillate wells and therefore corrosive.

Flange Design

The stress analysis of these flanges was made in accordance with the ASME Unfired Pressure Vessel Code, using an analysis sheet modified from the calculation Sheet C in the 1950 edition of "Modern Flange Design," by Taylor Forge and Pipe Works. Modification of this sheet consisted of the elimination of the temperature factors, a substitution of a new moment and moment arm for bolting-up condition to take care of the face-to-face make-up of the flanges, and the substitution of the axial component of the gasket-contact load for the minimum gasket force to maintain a tight joint.

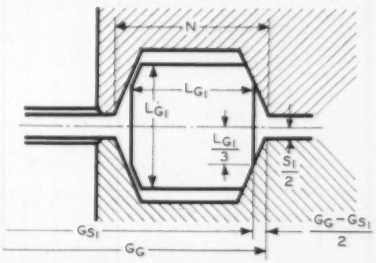

Fig. 7 Nomenclature for the final gasket design with 1/8-in. stand-off

A = OD of flange
α = Flank angle of basket and groove
B = Bore of flange
C = Bolt circle of flange
E = Distance from bolt circle to OD of flange
G = Seating diameter of gasket = OD of sealed gasket = G_{S2}
G_G = Groove OD
G_{S1} = Gasket OD, uncompressed
G_{S2} = Gasket OD, compressed
H, etc. = Pressure load on area of G
b = Hub length of flange
J = OD of flange contact face
$K = \frac{A}{B}$ = Ratio of flange OD to flange bore
L_{G1} = Gasket height
M = Flange bending moment
N = Groove width
P = Working pressure
Q = Groove depth
R = Distance from bolt circle to junction of hub of flange
S = Allowable bolt stress
S_F = Allowable flange stress
t = Flange thickness
$t_g = L_{G1}$ = Gasket width

All other notation is as used in the ASME Unfired Pressure Vessel Code, in the flange-design section.

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The calculation proceeds as follows

Minimum wall thickness of the hub, g_0, is determined by Lamé's formula

$$\frac{B}{2}\left[\left(\frac{S_F + P}{S_F - P}\right)^{1/2} - 1\right]$$

where

S_F = 37,500 psi ($^1/_2$ of 75,000-psi yield point)
P = 15,000-psi working pressure

$$g_0 = 0.26376B \quad \ldots\ldots [1]$$

h_1 the length of the flange hub was arbitrarily selected as

$$h \approx (2B)^{1/2}$$

and the taper was made 1 in 4.

Therefore g_1, the thickness of the hub at the junction with the flange, becomes

$$g_1 = g_0 + \frac{h}{4} = 0.26376B + \frac{1}{4}(2B)^{1/2}$$

$$= 0.26376B + 0.35355 \times B^{1/2} \quad \ldots\ldots [2]$$

The nearest fractional dimension above these calculated minimum values was used.

The next step is a calculation of bolt size and a determination of the flange outline, except the thickness.

The bolt load must balance the sum of these two forces:

(*a*) The pressure load on the outside seating area of the gasket

$$H = G_{S2}{}^2 \frac{\pi}{4} P$$

where $G_{S2} = 0.998B + 0.8542 \times B^{1/2} + 0.0156$ in. [3]

(*b*) The axial component of the gasket pressure load

$$H_{GP} = \pi\, G_{S2}\, L_{G1}\, P \tan \alpha \quad \ldots\ldots [4]$$

Therefore the minimum required root area of the bolts is

$$W_{min} = \frac{H + H_{GP}}{S}$$

where S = 52,500 psi ($^1/_2$ of 105,000 psi yield point). [5]

Now, a selection must be made as to the number of bolts. This number is customarily a multiple of 4. The minimum number should be 8 to prevent excessive bolt spacing. Also, bolts over $1^1/_2$-in. diam are very difficult to tighten properly in the field. Therefore 8 bolts were used in all flange sizes where the bolt size did not exceed $1^1/_2$ in., and thereafter a larger number should be used.

From the calculated W_{min} the nearest larger standard bolt area is selected, giving the actual area, W_{act}.

To arrive at the proper bolt circle, the corresponding wrench-clearance dimension R from Sheet A in "Modern Flange Design" is taken and added on both sides of the large hub diameter

$$C = B + 2g_1 + 2R \quad \ldots\ldots [6]$$

The nearest larger sixteenth dimension is selected for C. Adding twice the edge distance, also taken from Sheet A, gives the flange diameter

$$A = C + 2E \quad \ldots\ldots [7]$$

The next dimension required is the diameter of the flange face. Neglecting the small contact area inside the gasket groove, and setting the contact pressure at the low value of 25,000 psi, the required area is

$$\frac{W_{atm}}{30{,}000}$$

Using the letter J for the OD of the contact face, the required dimension is

$$(J^2 - G_G{}^2)\frac{\pi}{4} = \frac{W_{atm}}{30{,}000}$$

$$J^2 - G_G{}^2 = \frac{W_{atm}}{7500\pi}$$

$$J = \left(\frac{W_{atm}}{7500\,\pi} + G_G{}^2\right)^{1/2} = \left(\frac{W_{atm}}{23{,}562} + G_G{}^2\right)^{1/2} \quad \ldots\ldots [8]$$

From now on the modified Sheet C can be used to calculate the bending moments and to arrive at the flange thickness t. This dimension is taken as the distance from the bottom of the gasket groove to the back face of the flange, in the same way as in the ASME Code.

Results and Conclusions

The $2^1/_{16}$-in. and $7^1/_{16}$-in-bore flanges have been subjected to a strain-gage analysis by the Southwest Research Institute in San Antonio, Tex. Maximum stresses in the order of two thirds of the calculated stresses were found at the junction of flange and hub and at the circumference of the hub itself.

Regular production flanges in the $1^{11}/_{16}$-in. and $2^1/_{16}$-in. sizes on valve bodies have been subjected to 25,000-psi test by the author, and none of these flanges have shown any ill effects from this stress of 60 per cent over working pressures. Some of these flanged valves are now installed on Christmas trees in the field at pressures above 10,000 psi.

In conclusion, the contributions in engineering time and money made by the companies in the wellhead industry, together with the help of user companies, have enabled the Association of Well Head Equipment Manufacturers, and the engineers on its Standardization Committee, to present to the petroleum industry three important developments:

1 A standard for flanges for 15,000-psi-working-pressure service which will make all production equipment interchangeable.

2 A proved method for designing special closures such as valve bonnets, blowout-preventer bonnets, and so forth, for high-pressure service.

3 A ring-gasket design method which will materially improve the sealing ability of present API flanges.

The Safe Use of Isotopes in Industry

If handled correctly, intelligently, and with the proper amount of respect, radioisotopes and radiation can be safe

By William A. Brobst

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INDUSTRY, agriculture, and medicine have found many uses for radioisotopes in the past few years, but many potential large-scale uses for isotopes and radiation are still to appear. The use of isotopes is already saving over $500 million annually in return for a direct outlay of about $3 million annually. By 1960, these savings should increase to $5 billion. Isotopes will probably soon be paying the way for the entire atomic industry, including weapons and power programs, as represented by these savings.

Any forward-looking firm will want to investigate ways to make use of this valuable commodity. Even the smallest industry can make use of the atom in such a way that the net result is a gain in production, efficiency, and economy.

However, as with so many of the technological advances which have proved of use to industry, certain hazards appear that were not present before. With isotopes, the hazard is radiation. Although radiation is generally considered by the public to be about the most dangerous thing imaginable, the atomic-energy industry is at present about the safest of all industries. One of the reasons is that radiation hazard has been investigated to a far greater extent than most hazards.

Before considering details on safety problems, however, let us look at some of the uses of isotopes which have become rather common.

Radioisotope Uses

Isotopes are atoms which are identical as far as electronic structure, but dissimilar only in the relative mass of the nuclei.

By introducing a radioactive hydrogen atom into sugar, for example, it is possible to have a radioactive sugar which tastes and acts exactly like ordinary sugar. However, when it has been eaten, the movement of those molecules can be followed by the use of sensitive detection instruments.

Oil pipeline markers. Oil flowing in pipelines can be tagged with isotopes at a certain point in the flow, and their penetrating radiation can be measured through the walls of the pipe. The interfaces between different batches of oil which may be flowing in the same pipe can be tagged. It is then possible—without sampling, stopping the flow, making visual observations of the oil, or viscosity measurements—to learn when one batch passes a switch-point valve so that the valve can be turned to divert the following charge in the appropriate channel.

Gages. Over 3000 different types of isotopic gages have been licensed. Thickness gages are used in the production of paper, rubber, tire fabrics, plastics, glass, and other manufacturing operations where continuous, nondestructive gaging of thickness is desired. Such gages have improved product quality and uniformity, have speeded plant operations, and have reduced wastage of materials. These gages generally produce savings equal to their purchase price in a year or less!

Density gages have found much use in the cigarette industry, with more than 2000 licensed so far. Other types of gaging include measurement of liquid levels, moisture content, and hydrogen-to-carbon ratio (in preparation of petroleum products).

Industrial radiography. Over 600 firms are using isotopes for radiographic testing, frequently at one tenth the cost of x-ray radiography. Because of the compact size, radiographs can be taken of welds and castings where x-ray equipment would not fit. The higher energy of the radiation usually gives clearer pictures than x rays. Millions of dollars are saved each year through this one method.

Wear studies. Almost all motor-research laboratories have adopted radioactive tracing for studying wear of piston rings and other moving parts. Other applications include corrosion studies, tracing of lubricants, and the efficiency testing of washing equipment and detergents.

Radiation sources. Practical application of million-curie radiation sources is about to be realized for food preservation, sterilization of drugs and medical supplies, and as catalysts for plastic reactions. Very small sources in the form of photographic light meters, air-ionization devices, luminous light switches, electric batteries, and a host of other items are in the process of being perfected.

Cobalt-60 teletherapy sources are becoming more common every day. Compared with x-ray therapy, there is less reaction of the skin, less discomfort to the patient when deep therapy is indicated, and deeper penetration into the body for treatment of deep-seated lesions. Cesium-137 may provide almost as good therapeutic possibilities as cobalt-60. It has a longer half life and is more readily available.

Radioisotopes in agriculture. Savings from the use of isotopes in agriculture may amount to over $200 million a year. Eradication of various pests, fertilization experiments, and soil-erosion programs are but a few of the many projects under way at the present time.

Safety Problems

Aside from possible toxic effects of the elements themselves, there are two primary hazards involved in the handling of radioisotopes. One is the external exposure a person can receive merely by being in the vicinity of a quantity of radioactive material, and the other is the intake of radioactive material into the body, either by inhalation of the dusts or fumes, or by ingestion into the gastrointestinal tract as a result of contamination of hands, food, beverages, cigarettes, or other material which can carry contamination into the body.

The seriousness and type of hazard for any facility using isotopes depend primarily upon the amount of the isotope present; whether it is solid, powdered, liquid,

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or in some other form; and its biological effects. With very small tracer amounts for laboratory or field work, the external hazard is usually small, but the contamination problem might be significant. With sealed sources, as in radiographic or teletherapy units, the contamination is usually not a serious problem, and the external radiation levels are the governing factors. Each case will require special rules and regulations.

Radiation *can* be hazardous and even dangerous. So can gunpowder, alcohol, and automobiles. But, if handled correctly, intelligently, and with the proper amount of respect, radiation can be a perfectly safe and useful item. We cannot expect persons to handle radioactive materials safely and intelligently unless we educate them in the proper handling methods and, perhaps more important, the reasons for these precautions.

If employees are told that a hazard exists and the required precautions are explained, they will help solve most of the safety problems.

A plant that has taken the time and trouble to educate its employees thoroughly on the hazards of the various jobs before putting them into use is usually a plant with a good safety record. The fact that radioactivity can be hazardous should not deter any firm from investing in radiation devices or methods which will benefit them. If properly handled, these can be many times safer than most processes involved in manufacturing or research.

Safety Program

The extent of the safety program is, of course, dependent upon the scope of the radiation work. If the use of radiation is a very minor one in a plant, and the quantities of radiation are small, the personnel requirements for radiation safety are correspondingly small. If the program is a large and varied one, with considerable amounts of radioactive material, more personnel and more training are needed in order to carry out an effective safety program. A single person, trained in the safe use of isotopes, can mean the difference between a safe, efficient, and economical program and an unsafe, expensive proposition. Such a person must have the backing of a radiation-safety-conscious management. Some of his duties would be to: (*a*) Insure that every worker selected to handle radioactive materials has suitable physical and mental requirements to qualify him for the work to be performed; (*b*) be responsible for the instruction of new personnel in safe working practices and in the nature of injuries resulting from overexposure to radiation; (*c*) establish and maintain operational procedures so that radiation exposure of each worker is kept as far below the maximum permissible as possible; (*d*) insure that personnel-monitoring devices are properly used where indicated; (*e*) insure that suitable warning signs and devices are in place and operating as required; (*f*) conduct radiation surveys, leakage tests, air and water sampling where required, and keep records on these surveys for future use by other groups; (*g*) insure that shielding, storage containers, and handling equipment are maintained properly; and (*h*) maintain up-to-date operating instructions for the radiation equipment.

The job of the radiation-safety supervisor consists of considerably more than just the mechanical function of checks and measurements. The most important practical duty of safety personnel, and of management, is to inform all individuals working in a restricted area, of the presence of radioactive materials or radiation in that area; and to instruct them in the hazards of excessive exposure to such materials or radiation, and the precautions or procedures to minimize exposure. He must then insure that these procedures and precautions are carried out.

Instruction manuals and written procedures are necessary to insure that all persons have the same information, and handle the material in the same way. Without complete, understandable, and up-to-date instructions, the methods of operation will change according to individual whims. To prevent this, current continuing instructions should be made readily available to all employees.

Other factors must be considered. Hazardous areas and equipment should be properly marked and labeled with danger or caution signs to inform people of the presence of the hazard. Radiation-survey instruments and personnel-monitoring devices must be procured and used properly to detect the invisible tasteless, odorless radiation, and insure that persons are not working in areas which could result in an overdose.

There is a wealth of material available on radiation safety at a very nominal charge from the government, and will be of great value in making up rules and regulations for your own plant or laboratory.[1]

Summary

Sight must not be lost of the fact that the fundamental purposes of protective measures in the handling of radioisotopes are to prevent ingestion, inhalation, or other modes of entry into the body, and to reduce the amounts of external radiation to permissible levels. The first requirement is fulfilled by good housekeeping and work habits, and by operation in a facility properly equipped for the handling of isotopes, including protective coverings, manipulative devices, suitable ventilation, and waste facilities. The second requirement is taken care of by proper installation of the material with regard to shielding, remote-handling, and monitoring setups, and by observance of working times and conditions in radiation areas.

It cannot be emphasized too strongly that, if the proper precautions are taken and the hazard is recognized for what it is, radioactivity can be utilized by industry with a maximum of efficiency and economy, and a minimum of danger. By the proper initial design of facilities and by the institution of safe, workable operating procedures, the hazard from radioactivity should cause no more concern than other industrial hazards. The whole problem with radiation safety hinges upon education and understanding of the basic principles of safety. The majority of the few radiation accidents to date were caused, basically, by lack of education or misunderstanding of the hazards involved.

[1] There are the various handbooks of the National Bureau of Standards, available from the Government Printing Office, covering such topics as "Safe Handling of Radioactive Isotopes," and "Control and Removal of Radioactive Contamination in Laboratories." There are two on maximum permissible doses and levels of radiation: "Protection Against Radiations From Radium, Cobalt-60 and Cesium-137," "X-Ray Protection," and others. The Code of Federal Regulations, Title 10, Part 20, entitled "Standards for Protection Against Radiation," gives the Atomic Energy Commission's rules for radiation safety. The TID 8000 series, a set of government publications on industrial uses of radioactivity, called "The Industrial Atom," has a great deal of useful information.

THE application of recent technological developments in rubber compounding, and in textile fiber research as they apply to conveyer belt construction

The 4200-ton-per-hr conveyer system located at Promontory Point, Utah, used for moving gravel and aggregate to the lake shore. Thirty million tons are moved to barges on this 2-mile downhill belt.

Designing Belts for Material Handling

By F. W. Blanchard

Vice-President, Hewitt-Robins Inc., Stamford, Conn.

THE quantity of conveyer and elevator belting put into service annually by industry, mine operators, and contractors has increased more than 50 per cent since 1952. Purchases of belting for handling bulk and packaged materials exceeded $60 million in 1956. Significant economic and technological developments account for this steady growth and rapid rise. Among these are: Expansion of industrial and mining production, the continued demand for more horsepower per man to offset rising wages, and improvements in materials and manufacturing methods for conveyers.

A series of improvements in the 150 years or more that belt conveyers have been in existence has extended their usage for moving bulk material from hopper to crusher, crusher to further processing, to and from storage, and to and from car and barge-loading tipples and car dumpers. Increasing application is being made to overland transportation systems.

For a successful installation, the conveyer belt must

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Table 1 Friction Factor

Idler pulley diam, in.	Friction factor C: First 500 ft of length	Friction factor C: After first 500 ft of length
4	0.0375	0.031
5	0.036	0.030
6	0.030	0.025
7	0.025	0.021

Table 2 Q Values, Lb of Moving Parts per Ft of Empty Conveyer

Conveyer width, in.	Trough idler spacing	Belt weight average, lb	Q, lb per ft
5-in. idlers			
24	5 ft	7.0	20.9
30	4 ft 6 in.	8.5	26.0
36	4 ft 6 in.	11.3	33.1
42	4 ft	17.0	46.9
48	3 ft 3 in.	23.8	64.8
6-in. idlers			
54	2 ft 9 in.	29.2	90.7
60	2 ft 3 in.	32.5	106.6

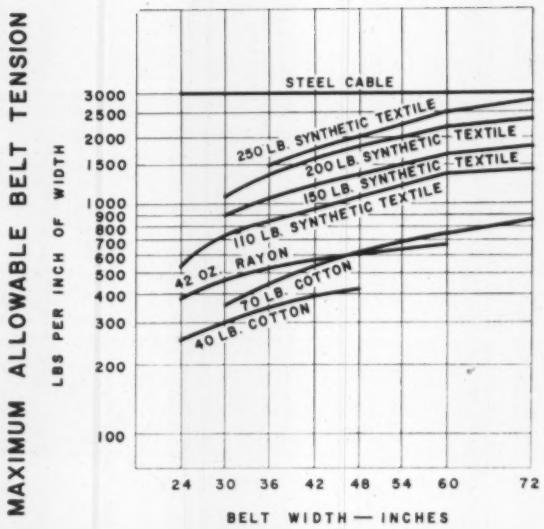


Fig. 1 Rating curves for high-tension conveyer belts by belt width and construction

satisfy certain major considerations. It must provide a moving wear, heat, and deterioration-resistant surface. A satisfactory tension member must be included to withstand the tension required to move the belt and material over the length of the system, and to limit elongation of the belt. Sufficient flexibility must be provided to prevent premature failure from flexing and to permit easy bending around head and tail pulleys. Sufficient contact is necessary to transmit the drive horsepower to the belt. Sufficient lateral flexibility is necessary for ready troughing both loaded and empty.

The two major components of a conveyer belt are generally referred to as the cover and the carcass.

Covers for Conveyer Belts

Developments in natural and artificial rubber have made a variety of materials available for belt covers.

For general service, requiring primarily resistance to abrasion, compounds of properly reinforced natural rubber, cold GR-S, and blends of these copolymers are most economical.

When an oil or grease condition exists, neoprene or buna nitrile compounds are required.

To resist excessive heat, compounds of neoprene or butyl rubber offer the most satisfactory properties.

For flame resistance, neoprene compounds and vinyl compounds currently are the best available materials.

All major belt manufacturers are prepared to provide information on the proper compound for each type of material and service condition.

The primary cause of cover deterioration and wear is abrasion. Although some wear of the top cover takes place at belt scrapers, cleaners, trippers, and discharge points, most of it takes place at the loading points. Proper design and control of the following units can greatly reduce the rate of wear and increase the life of the belt cover: (*a*) Proper skirt-board design so that it does not "ride" the belt cover yet confines the material to the proper width. (*b*) Material should be chuted onto the belt in the direction of travel, and protected from impact when chuting from heights over 6 or 8 ft, or from angles lateral to or opposed to the direction of belt travel. (*c*) When severe conditions of abrasion or impact are encountered, it may be advisable to use a feeder or speed-up belt to "take" the impact and wear, and deposit the material on the long line belt in the direction of belt travel at nearly belt speed. (*d*) The number of cycles per hour or the number of times per hour a given section of belt passes the loading point has a great effect on the cover life.

Design of a Conveyer Belt Carcass

In view of the volume of published material regarding cotton fabrics, only recent trends in conveyer belts will be considered.

The advent of high-tenacity rayon and treated cotton has written a new chapter in the progress of the long-length, high-tension belt-conveyer system ushered in nearly a decade ago by the monocord, cord-fabric, and steel-cable constructions. Fig. 1 shows the allowable working stress in pounds per inch of belt width for the typical types of material available for conveyer-belt carcass construction.

Improved laboratory-testing equipment such as the Hewitt-Robins belt-testing dynamometer, Fig. 2, has permitted the design of fabrics and belt carcasses for high-tension service with greater safety. Progress has been made in improving the metal-fastener holding strength of textiles and in evaluating and improving vulcanized splice techniques for high-tensile belt.

High-tensile fabrics now rival the tensile strength of steel, retaining suitable troughability for conveyers 30 in. and up, while offering the advantages of lower initial cost, easier processability, safer and simpler splicing techniques, and spread of the working load over more carcass elements.

Selecting the High-Tension Belt

The high-tension belt requires a far more thorough analysis of load strength and tension factors than has been

Fig. 2 A belt-testing dynamometer permits the design of fabrics and carcasses for extremely high-tension service with greater safety. It has helped in evaluating vulcanized splice techniques and metal-fastener holding strength of textiles.

necessary for the average system of the past. Discussion will be confined to the long-length, high-lift conveyer systems, since the same principles could be applied to the design of a conventional belt.

The basic elements of a system are: the belt, supporting idlers, pulleys and trippers, drive, and supporting structure. The design and specifications are based on an analysis of the power and tensions required to overcome the several resistances and loads. These have in the past been computed as six load components: (*a*) Move empty belt over idlers, (*b*) move load horizontally, (*c*) lift or lower load, (*d*) tripper losses, (*e*) to turn pulleys, (*f*) drive losses.

Good handbook data are available on the last three items. Determination of the energy required to lift or lower the load is simple and noncontroversial, being directly calculable as foot-pounds per minute.

The effects of variations in idler spacing, belt tension, belt stiffness, and idler friction due to difference in belt construction, and type of load, have, until recently, been considered one factor developed by measuring actual over-all power consumption on many installations under varying conditions.

One such formula in common usage today for calculating belt tensions and horsepower at the motor shaft is

$$\text{hp (at motor shaft)} = \frac{0.03\ LSCQ}{990} + \frac{CLT}{990} + \frac{TH}{990} + \text{trippers} + \text{pulley friction} + \text{drive losses}$$

L = length of conveyer, ft
S = belt speed, fpm
T = capacity, short tons per hr
H = height of lift or drop, ft
C = idler friction factor (Table 1)
Q = weight of moving parts per ft of conveyer (Table 2)

The 0.03 and 990 are constants to convert ft-lb per min into hp.

Factor C (Table 1), which we have termed idler friction, provides allowances for many intangibles besides the power needed to turn the idler rolls. Among these conditions are: Variations in temperature and maintenance, flexure of belt and shifting of load at each idler, idler spacing, belt tension, and many other minor variables caused by difference in belt construction, type of idler, and type of load.

This approach, while generally workable, combined so many unknown variables into one empirical factor that it was necessary to be conservative in application. Consequently, most systems in the past have been overpowered and overbelted with higher initial cost and higher operating cost than necessary.

In June, 1953, under a grant by Hewitt-Robins, Pennsylvania State University began an investigation of the effect of these various factors at its Minerals Industry Experimental Station. Penn State developed techniques to analyze separately the power consumed by troughing idlers, return idlers, return strand of belt, and the carrying belt both loaded and unloaded. Findings were checked by gathering detailed data on 19 conveyer installations under varying load and weather conditions. It was found that idler resistance-to-turning had far less effect on power consumption than had been supposed, and that idler spacing and belt tension had a sizable effect on power required. This latter power is absorbed in flexing of the belt between idlers and in "squeezing" the load (shifting and lifting) at each troughing idler.

From these findings, a new formula has been developed which permits breakdown of two of the old components into four, each having its own calculated factor. The old factors were: (*a*) Move empty belt over idlers, and (*b*) move load horizontally. These are now divided into: (*a*) Resistance of return idlers, (*b*) resistance of troughing idlers, (*c*) resistance of return belt, (*d*) resistance of trough belt and load.

The new formula for calculating effective tension required to move the belt and load over the system is

$$T_E = N_1 I_1 + N_2 I_2 + K_1 LB + K_2 L\ (B + M)$$

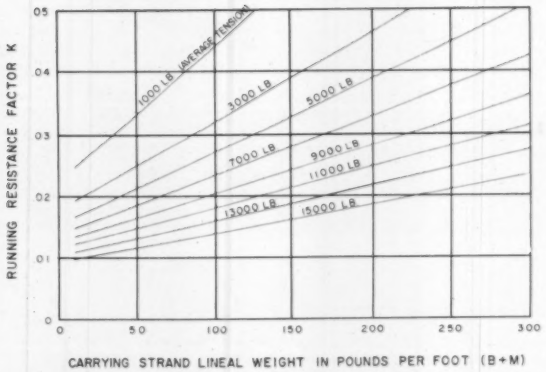
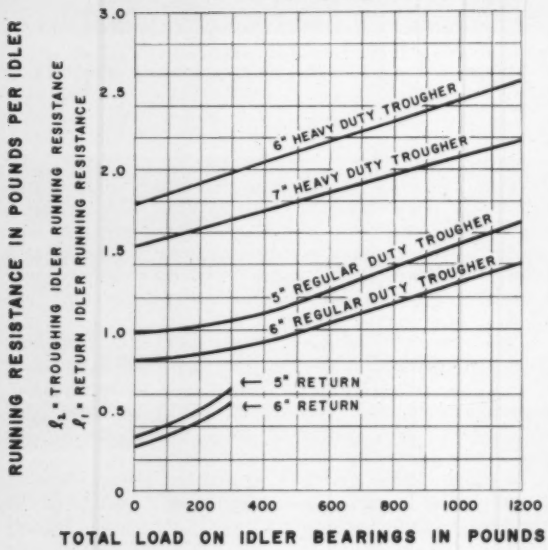


Fig. 3 The K_2 factors for varying conditions of belt tension with 4-ft idler spacing

Fig. 4 The l_1 and l_2 factors for various size troughing and return idlers



where

T_E = effective tension
N_1 = number of return idlers
N_2 = number of troughing idlers
l_1 = resistance return idlers
l_2 = resistance trough idlers
K_1 = resistance return belt = 0.015
K_2 = resistance trough belt and load
B = lineal weight of belt
M = lineal weight of load
L = weight of conveyer

If incline or decline is present, the tension required to lift or drop the load must be added. If a tripper is involved, the effective tension required to operate the tripper must also be added. From this *effective tension*, the hp required to move the belt and its load can be calculated. In order to compute the hp required at the motor shaft, the power required to turn the pulleys, including bending belt around pulleys, and to overcome drive losses must be added. Fig. 3 shows the K_2 factors for varying conditions of belt tension with 4-ft idler spacing. Fig. 4 shows l_1, l_2 factors for various size troughing and return idlers.

Many additional data must be collected by testing idler, belt, and load resistances under different combinations of type of belt, type of idler, type of material, varying slopes, degrees of belt tension, and varying climatic conditions. For example, under various conditions a K_2 factor for a given belt construction, type of idler, and belt tension may require adjustment for the type of material; that is, dry sand, wet sand, iron ore, coal, or others.

In 1956, Hewitt-Robins designed and built a 2-mile, downhill conveyer system for the Morrison-Knudsen Company, which is located at Promontory Point, Utah, in Great Salt Lake. Thirty million tons of gravel and aggregate are moved from a gravel pit to the lake shore. This gravel is then loaded onto barges which transport the material out into the lake to form the ballast for the solid-earth fill for the new two-way track system for Southern Pacific Railroad. The two main-line belts of this system are 54 in. wide, 4000 and 3850 ft long, respectively, and travel at 850 fpm. This installation has presented the opportunity to collect data on the highest tonnage, high-speed earth-moving system ever installed in the United States. Much useful information on idler resistance, belt and load-hysteresis losses, accelerating and decelerating loads will be developed from this program.

Conclusions

Improvements can be expected in many ways from continuing developmental activities.

Belt covers made from new formulas and as yet undeveloped polymers will offer increased resistance to abrasion, cutting, tearing, weathering, heat, cold, oils, and chemicals.

Better adhesives will assist in splicing and in preventing delamination of covers and plies from severe service, or accident.

Reinforcing materials of suitable flexibility and greater strength are already under test in the laboratory and in pilot installations.

Technological advance, increased volume, and standardization will permit economies in manufacturing and distribution to further broaden the field of economical use of belt conveyers.

A wide selection of fuel, including the use of waste gas, is making the gas turbine attractive and economical for gasifier, integrated pressurized process, extraction unit, and power generation applications

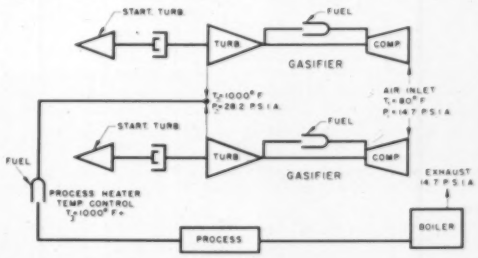


Fig. 1 Schematic of a gasifier application utilizing two machines with common discharge for the regeneration of the catalyst in a butadiene process

GAS TURBINES FOR PROCESS APPLICATIONS

By D. F. Bruce

Industrial Gas-Turbine Engineering, Westinghouse Electric Corp., Philadelphia, Pa.

Economy of installation and competitive operating costs for gas-turbine power plants are rapidly establishing an important position for them in the chemical and process industries. The large amounts of thermal energy delivered in the exhaust at usable temperature, and the ability to use a wide selection of fuel, including the waste gas of some processes, have made them extremely attractive.

They are particularly suited for requirements such as the supply of compressed air, hot gases, and mechanical power, or various combinations of these requirements. To simplify discussion, these applications are divided into four major categories:

Gas-Turbine Gasifiers

The gas-turbine gasifier is a machine capable of supplying large amounts of hot exhaust gases at moderate pressure, and varying amounts of mechanical power. These can be supplied up to 28 psia and at 700 to 1000 F. The gas-turbine gasifier is particularly useful with those processes that require hot gas with a large amount of the air's oxygen still unused. Its configuration usually consists of a single-shaft gas turbine that has been modified to provide for a pressurized exhaust. In addition, the turbine component is arranged to develop the work required to drive its air compressor. The balance of the energy input is delivered to the process in the form of pressurized high-temperature exhaust gases. Depending upon circumstances, this machine can be arranged to deliver power, be self-sustaining, or to require boost power. This is determined by such factors as process back pressure, component efficiencies, and metallurgical consideration.

Fig. 1 is a schematic diagram of the air-and-hot-gas circuit of a butadiene process utilizing two gas turbines as gasifiers. The air compressor takes suction from the atmosphere, and a standard combustor configuration is used to heat its discharge to that temperature required for the turbine portion to supply mechanical energy equal to that absorbed by the compressor. This temperature, of course, is influenced by the back pressure imposed by the resistance of the process. The catalyst bed is located in the exhaust line, and the gasifier is required to deliver its exhaust at a pressure sufficient to overcome the resistance of the fixed bed, associated piping, and any attached heat-recovery apparatus. The cycle illustrated is one in which the components have been so arranged as to provide a self-sustaining machine; the fuel flow is adjusted automatically by a governor to maintain gasifier speed.

The process is endothermic, and requires periodic heating and regeneration of the catalyst bed. Air must be delivered to the catalyst bed in excess of 1000 F. The application is particularly interesting from a thermodynamic standpoint as regards the fuel expenditure required. The heat energy required for a given air-temperature rise above atmospheric conditions is independent of the path followed on a temperature-entropy diagram. Therefore the fuel energy can be determined from the following

$$\text{Fuel energy, Btu per lb of air} = {}_1h_3 = C_P(t_3 - t_1)$$

A gas temperature of 1100 F to the process will require 255 Btu per lb of air delivered. This amount is required regardless of the back pressure. Therefore at lower back pressures the process combustor would be required to burn additional fuel, as the discharge temperature of the gasifier's turbine decreases with a decrease in back pressure. However, the total fuel required will remain the same, whether it be burned in the combustor of the gasifier, or in the process combustor.

Other methods of supplying hot gases are available, such as a separately driven compressor with a combustor to raise the temperature to that required by the process. An examination of the thermodynamic characteristics of this method results in the following comparison on a basis of process pressure requirements:

1 Assume radiation and other losses are small and can be neglected

Contributed by the Gas Turbine Power Division and presented at the Annual Meeting, New York, N. Y., December 1–6, 1957, of The American Society of Mechanical Engineers. Paper No. 57—A-140.

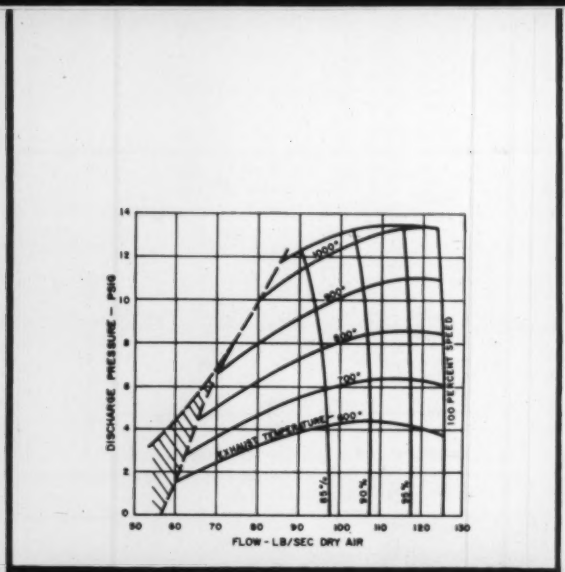


Fig. 2 The 98,000-scfm gas-turbine-gasifier performance characteristics

2 Required air temperature to process—1100 F
3 C_P air assumed—0.25 Btu per lb $K = 1.4$
4 Adiabatic efficiency of separately driven compressor—$n_1 = 75$ per cent
5 Over-all thermodynamic efficiency of compressor drive—$n_2 = 25$ per cent

With the above assumptions, the following equations can be developed:

(*a*) The enthalpy delivered to the air within the compressor casing is given by

$$_1b_2 = y = \frac{W}{J} = \frac{C_P T_1 \left[\left(\frac{P_2}{P_1} \right) \frac{K-1}{K} - 1 \right]}{h_1}$$

(*b*) The fuel energy required by the drive of the compressor is given by

$$\text{Fuel energy (required by compressor drive)} = \frac{Y}{n_2} \text{ Btu per lb of air}$$

(*c*) The total fuel energy required to deliver the air to the process at the required temperature and pressure is indicated by

$$\text{Fuel energy per lb of gas} = C_P (t_3 - t_1) - Y + \frac{Y}{h_2} \text{ or}$$

$$= C_P (t_3 - t_1) + \frac{(1 - n_2) C_P T_1 \left[\left(\frac{P_2}{P_1} \right)^{\frac{K-1}{K}} - 1 \right]}{n_1 n_2}$$

which results in the following for the required process conditions

$$\text{Fuel energy per lb of gas} = 0.25 (1100\text{–}80) + \frac{0.75}{0.75 \times 0.25} \times 0.25 \times 540 \times \left[\left(\frac{28.2}{14.7} \right)^{\frac{0.4}{1.4}} - 1 \right]$$

$$\text{Fuel energy per lb of gas} = 255 + 110.5 = 365.5 \text{ Btu per lb of gas}$$

The ratio of the fuel required by two configurations for the condition cited is 1.43; or the separately driven compressor configuration requires 43 per cent more fuel per lb of air delivered to the process. This would amount to a fuel cost saving of $230,000 per yr using a gas-turbine gasifier for a process requiring 240 lb of air per sec with a fuel cost of 30 cents per million Btu.

These are the advantages of the gas turbine's rejection of heat in usable form. In those cases where the exhaust pressure required is low, the full capability of the power plant can be utilized by arranging it to produce mechanical power as well as hot exhaust gases.

The performance characteristics of a gas-turbine gasifier designed for an air flow of 120 lb per sec are indicated by Fig. 2. The limiting parameters are speed, compressor surge, and cycle temperature. Turbine-exhaust temperature is indicated as a parameter on the plot of discharge pressure versus flow. The exhaust temperature developed by the gasifier is a function of the back pressure established by the process, and is not controlled by the turbine. It is developed as a result of the temperature on the inlet of the turbine required to produce the energy to drive the compressor. A flow variation from approximately 70 to 125 lb per sec can be obtained by speed variation.

Fig. 3 is a picture of two gasifiers in operation at a butadiene plant. The exhaust of these machines is manifolded without the use of isolation or check valves. Starting power is supplied by steam turbines which are connected by an air clutch. These machines have been arranged for single or parallel operation and have been on steam since March, 1957.

Gas-Turbine Integrated Pressurized Process

The integrated pressurized process application of a gas turbine is a method of supplying large air requirements to a process at a pressure level of 3 to 8 atm with the production of varying amounts of power according to the system arrangement and pressure drops.

The compressor takes suction from the atmosphere and delivers the air at the required pressure. In this type of installation an intercooler between compressor stages would normally be used for pressure ratios in excess of 6:1. The discharge of the compressor is routed through the process and then to the turbine. Most of the applications examined to date discharge the air from the process at elevated temperature and at appreciable pressure levels. The fuel required by the gas turbine can be added before or after the process depending upon process requirements. The maximum temperature to the turbine component is limited by metallurgical considerations. The work balance between the compressor and

Fig. 3 Two gasifiers in operation at a butadiene plant

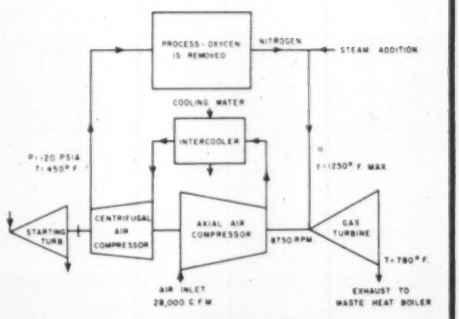


Fig. 4 Schematic pressurized process used in the manufacture of nitric acid

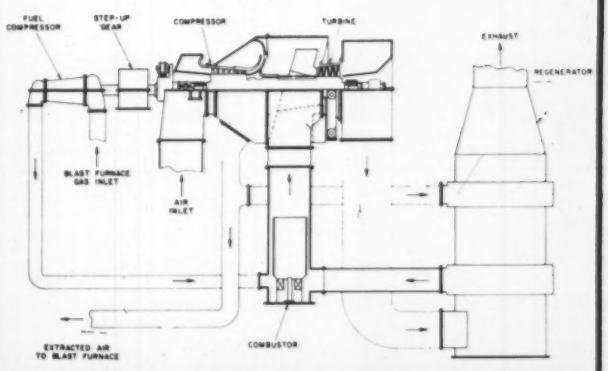


Fig. 5 Schematic of 125,000-scfm extraction-cycle gas turbine using blast-furnace gas for fuel

turbine is largely dependent upon the pressure loss of the process, and the balance can either be absorbed or made up as required.

The combined characteristics of this application depend upon the selection of the gas turbine, booster compressor, and intercooler in addition to the characteristics of the process. Hence it is rather difficult to illustrate a performance field such as that prepared for the gasifier. This is not because of complexity of calculation, but the number of possible combinations available; therefore some typical values have been included in Fig. 4 which schematically illustrate a process utilizing this type of gas-turbine configuration.

The limiting factors to be considered in this application are the analysis of the process exhaust and carry-over of solid particles that could be harmful to the turbine.

Fig. 4 is a schematic diagram of the air circuit of an integrated pressurized process used in the manufacture of nitric acid. The gas turbine is started by means of a steam turbine. The discharge of the gas-turbine compressor is passed through an intercooler, and then compressed to 120 psia and delivered to the process at a temperature of 450 F. The discharge of the process is heated to 1250 F in a catalytic combustor, passed through the turbine, and routed to a waste-heat boiler. The arrangement once started is self-sustaining, and the starting turbine is disconnected. The air flow to the process itself can be varied approximately 30 per cent by means of speed control of the gas-turbine set.

Gas-Turbine Extraction Unit

Many processes require the delivery of large amounts of compressed air at pressure levels of 15 to 40 psig which for various reasons are not returnable to the gas-turbine cycle. This has led to the development of an extraction-type gas turbine that has a stable pressure-flow characteristic from zero to maximum flow.

An extraction-type machine of this type is currently in process of manufacture. It will deliver 125,000 scfm of air at 35 psig and 355 F. This machine will be installed by the United States Steel Corporation at its South Chicago Works to furnish air for blast-furnace blowing.

The gas-turbine cycle utilized for this machine is illustrated by Fig. 5. Suction for the air compressor will be taken from outside the blower building. The discharge flow of the compressor is split so that approximately one third will be available to the process, and the balance is routed through a regenerator where it is heated by the exhaust gas. The hot air is then returned to a single external combustor which is fired with blast-furnace gas. This gas is taken from a supply main at a pressure of 8 oz psig and compressed to combustor pressure by a direct-driven axial-flow compressor. The combustor discharge is then passed through the turbine. The exhaust from the turbine is then passed through the regenerator, and then to the atmosphere.

The gas turbine will be cranked by a steam turbine, and assisted to approximately 2000 rpm. It will be self-sustaining once started and will use blast-furnace gas as its primary fuel. The secondary emergency stand-by fuel will be distillate oil.

Fig. 6 illustrates the performance characteristics of this machine. The cycle characteristics indicate that the machine will be extremely flexible and easy to control. Air will be available to the process from 0 to 100 per cent flow and at any pressure below the maximum speed parameter.

Gas-Turbine Power Generation

The fourth major category of applying gas turbines within the chemical process industries is in the development of mechanical power for direct drives, or the generation of electrical power. It offers an extended field as regards the application of gas turbines because of the requirements of appreciable blocks of power for mechanical drives requiring some speed range.

The gas turbine's ability to utilize the waste gases of different processes as fuel, coupled with a process heat balance that can use the exhaust energy of the gas turbine, is of great interest and importance as regards a process study to determine equipment selection. The exhaust gases of the gas turbine contain approximately 80 per cent of the oxygen of the intake air, and can therefore be used as preheated combustion air for a boiler, or as the energy supply for a process heat exchanger. The thermodynamic efficiency in some cases can approach 100 per cent depending upon the assumptions made as re-

Table 1 Pertinent characteristics of Westinghouse gas-turbine frames for mechanical drives and process applications

Model	Frame hp	rpm	Speed range, per cent	Press ratio	Air flow, lb/sec	Exhaust, temp F
W31M	3250	8500	±8	5:1	52	775
W52M	5300	6000	0–110	4:1	98	890
W81M	7800	5740	±8	6:1	118	740
W121M	12,000	4700	±8	6:1	195	690
W201M	22,500	3600	±8	6:1	365	725

W81B Exhaust gases to process 98,000 scfm @ 28.2 psia 1000 F
W201E Air to process 125,000 scfm @ 35 psig 355 f

gards charging the turbine-exhaust energy to the process or against the power output. The feasibility of an application can be determined by a detailed study, and depends upon the commercial availability of a gas turbine having suitable performance characteristics. In Table 1, characteristics of typical gas turbines, as manufactured by the author's company, are tabulated. Similar data are available from other manufacturers.

At the present time, ten gas turbines of the writer's company are installed in refineries as mechanical drives. Five of these machines are in operation and five are being erected. All of these machines use refinery waste gas as their primary fuel. Several of them are arranged to use alternate fuel supplies which vary in heating values from 800 to 2400 btu per scf. Fig. 7 is a picture of a 3250-hp frame machine ready for shipment. Five of these frames have been installed in three fluidized catalytic refineries as the drive for the main air and gas compressor.

A pressure-maintenance project installed by the Creole Oil Corporation of Venezuela has 12 single-shaft gas turbines installed on a platform erected on concrete piles some 12 miles from shore in Lake Maracaibo. The machines are arranged in two strings of six, and drive centrifugal compressors that are in series with external coolers between gas-compressor casings. Station suction is 55 psia with a discharge pressure of approximately 1950 psia, a pressure ratio of 36:1.

This application definitely illustrates the ease of applying single-shaft machines as regards adaptability and control. The serviceability, low maintenance, and minimum of operating personnel required are of importance for such remote locations.

The normal fuel supply is taken from the discharge of the number 2 compressor and supplied to the machines at 125 psig. The starting power for this application is provided by expansion turbines coupled to the machines by air clutches. The starting turbines are supplied with natural gas at 600 psig which is normally furnished by the opposite string aboard the platform. During cold start-up this gas can be back-flowed from an ejection well. This installation has been on steam since April, 1957.

In the use of gas turbines for the generation of electrical power, many of the installations utilize waste gas for fuel. This is particularly the case in such remote installations as those found in Venezuela, Borneo, and the Middle East where there is little use for fuels of rather good quality that can be utilized by gas turbines.

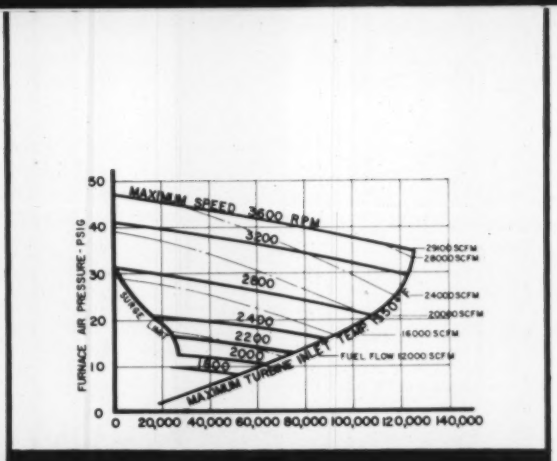


Fig. 6 Operating characteristics of 125,000-scfm extraction-cycle gas turbine

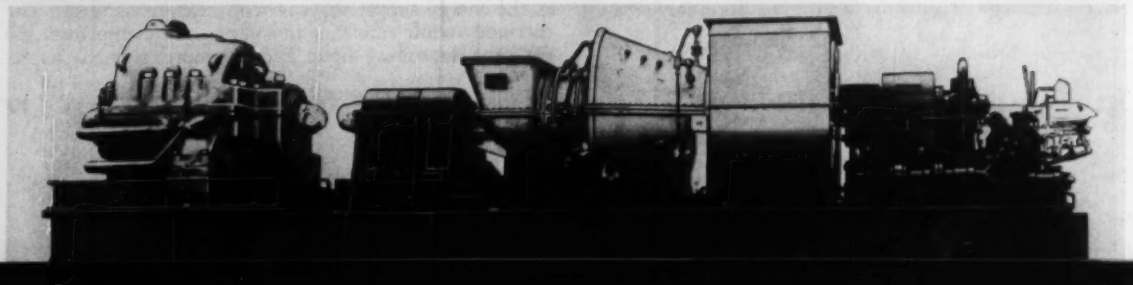
A development now under way in the United States extends a similar set of economic conditions for the employment of gas turbines in the generation of electrical power. The application is concerned with production of crude oil from shale. The most promising scheme available at this time utilizes a retort in which the shale is cooked, cracking the kerogen and releasing the shale oil. The principal by-product of the scheme is a waste gas of approximately 80 Btu per cu ft. The importance of this gas is that approximately one third of the thermal energy locked in the shale is delivered as this by-product.

The remote location, low Btu per cu ft, and low pressure at which this gas is delivered exclude the possibility of transporting it to any market. It is of great importance to the success of this scheme that the low Btu gas be utilized. The location and site conditions of the shale deposits are such that it would be extremely difficult to establish and justify any local industry development to use this fuel. At the present time, it appears that a gas turbine can utilize this gas as a fuel, and thereby convert it to electrical energy which can be efficiently transported to market.

Conclusion

Applications will continue to be made in the categories covered in this paper as well as in varying combinations. The place that the gas turbine is taking in industry can best be measured by the number of units placed in operation. While successful experimental gas-turbine units were available in the 1930's, it wasn't until 1945 that commercial installations were really started. In the decade from 1945 to 1955, approximately 125 units were installed and placed in operation. By comparison, 1956 and 1957 saw an equal number of a greater combined horsepower scheduled for installation than in the preceding decade. Many of the applications have been repeat orders showing that the gas turbine has proved itself in actual service, and that it should therefore play an ever-increasing role in providing power, compressed air, hot gases, or other needs for the process industries.

Fig. 7 A 3250-hp gas turbine ready for shipment as the drive for an air and gas compressor



How to UNDERSTAND an Annual Report

The corporate report, management's annual statement to the owners and employees, has become a readable instrument. Follow an expert as he breaks down the statistics.

By Weston Smith[1]

Managing Director, Weston Smith Associates, New York, N. Y.

THE corporate annual report, valuable to engineers, has taken on new appearance, readability, and usefulness. The reports have graduated from the elementary stage and broadened their scope. Recently, we have noted the "ivy look" in annual reports: They appear with a more sophisticated treatment.

The following quotation reveals the new approach:

"It is the policy of the management to be fully informative about the operations and financial position of your corporation. Our annual reports and quarterly earnings statements are provided to enable shareholders to follow closely the events affecting the corporation in which you have invested your money, your confidence, and your hopes for the future.

"The annual report, however, is more than a record of stewardship by the management to the owners of the corporation. It is the most important single document which your officers produce each year. It is prepared for the shareholders, but it is distributed to the company's employees, its dealers, customers, and suppliers. In addition, it is sent to financial and editorial writers of newspapers and magazines throughout the nation."

The Desire to Be Informed

"Requests for copies of the annual report are received from bankers, brokers, security analysts, libraries, universities, colleges, and business schools, plus government agencies (State and Federal), trade associations, professional societies, institutions, and individuals in all walks of life. Many small investors write for our report, and a percentage of these become new members of our shareholder family.

"Many persons form their opinions of our company and its securities almost entirely from what they read in the annual report, and how it impresses them. Thus we regard the cost of this means of communication as one of the best investments we make in public relations."

This concept of the modern annual report has spread at an accelerated rate throughout the managements of our leading industrial corporations and financial institutions. Today, almost two fifths of the 5000 annual reports rated in the *Financial World* competitions are explaining affairs to shareholders and providing information far beyond the necessary president's letter and the audited balance sheet, income account, and profit and loss statement for the one year.

There have been cycles in annual-report design since the start of the *Financial World* surveys. The initial crusade was aimed at encouraging more managements to add pictures and charts to their annual reports. The trend then turned toward a greater use of color and a modernization of layout. The pendulum swung from one extreme of inadequate financial statements to the other extreme of oversimplification of facts and figures. The promotional annual report, packed with advertising and sales appeal, was favored by many managements, especially those distributing consumer goods. Extra emphasis on color and advertising design often reduced the amount of information provided and subordinated the financial statements, which are the heart of any annual report.

[1] Formerly of *Financial World*.

Contributed by the Metropolitan Section's Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, and presented at the April Meeting, New York, N. Y., April 16, 1957, of the Metropolitan Section.

How to UNDERSTAND an Annual Report

The Well-Balanced Report

The well-balanced report, advocated by the author, has emerged as the most helpful to all classes of readership. The front half provides an introductory page with a brief table of contents, a high-lights page of comparative statistics, a one-or-two-page president's letter, and the narrative section, generously subheaded and illustrated with pictures (properly captioned) and simple charts (not more than three indexes in each chart). The back half of the report includes the two-year comparative financial statements (balance sheet, income account, and profit and loss or surplus analyses with necessary footnotes and the auditors' certification), plus a ten-year review of operating, income, and financial statistics.

The comparative balance sheet provides the figures for only two days: the closing day of two fiscal years. The Asset side of the balance sheet lists everything owned by the company, plus those things owed to the company. The Liability side lists everything the company owes, plus reserves, minority interests, capital, and surplus. The assets of a solvent company are always greater than its liabilities, and the difference is called the Net Worth.

Important to the average investor is the so-called "Current Position" or the ratio of current assets to current liabilities. Current assets include cash, government bonds, marketable securities, notes and accounts receivable, and inventories (raw materials and supplies, plus work in process or finished merchandise). Current liabilities include bank loans and commercial paper, accounts payable, debentures and other debts due within the coming year, tax accruals, and dividends declared but not paid. Deducting the current liabilities from the current assets gives the net working capital. Generally speaking the net working capital should equal total current liabilities, and if there is an excess of current assets, so much the better.

The working capital ratio is figured by dividing the current liabilities into the current assets, and if the ratio is better than 2 to 1, the current financial condition is satisfactory. However, a high ratio of over 6 to 1 might imply that the company has too much unemployed cash, too many unpaid bills outstanding, or an unusually large inventory of unsold merchandise.

A Sound Company

When judging the actual financial health of a corporation, it is well to check the "Net Quick Asset" position. By subtracting current liabilities from cash and equivalent and accounts receivable, the Net Quick Assets are determined. When current assets, less inventories, equal or exceed total current liabilities, a corporation is said to be in a sound financial position.

The average industrial company is in the best position when neither bonds nor preferred stock are outstanding ahead of the common stock. If there is bonded indebtedness, not more than 25 per cent of the total capitalization should be in bonds or funded debt. If both bonds and preferred stock are outstanding, the combination of funded debt and preferred stock should not exceed 50 per cent of the total capitalization.

Companies which value their good will, trade-marks, and patents at the nominal value of $1, or at zero, are in a better position than those that carry this intangible asset at millions of dollars. Depreciation of plant and equipment also should be noted, especially if there is a footnote explaining the depreciation policy of the corporation. It is always good policy to read all footnotes, even though they may be set in very small type, because here the independent auditors list the qualifications, exceptions, contingent liabilities, and any pending litigation. If the company has funded debt or loans outstanding which require that the management maintain a certain ratio of current assets to current liabilities or forbid any increase in dividend rate until certain requirements are met, these restrictions will be found in the footnotes.

The Income Account

The income account for the latest year provides a variety of information, but it is more helpful if the preceding year's income account is also available for a direct comparison. It is only within the past dozen years that the majority of publicly owned companies have been providing sales figures. Today, almost every listed corporation starts its income account with "Net Sales," which represents actual sales after allowances, discounts, refunds, and credits for faulty or returned merchandise. A service company, such as a railroad or electric company, will start its income account with "Gross Income," which represents payments for transportation or utility service.

The first deduction from Net Sales is "Cost of Sales," which includes the prices paid for raw materials, manufacturing wages, depreciation, maintenance, local taxes, fuel, and rent. Next is "Selling and Administrative Expenses," which include nonmanufacturing payments for executive and clerical salaries, salesmen's drawing accounts and commissions, advertising, promotion and public relations, plus other general expenses. This leaves the "Net Operating Income," to which is then added "Other Income," and this includes interest and dividends on securities owned, income from sale of assets, and other profits not considered as operating income. The amount after adding Other Income is available for interest on bonds or other loans, and if such a deduction is made, the balance left is the "Net Income Before Federal Taxes." When the Federal taxes, or the provision for Federal taxes is deducted, the remainder is the "Net Income After Federal Taxes," and if there are no special or nonrecurring deductions, this is the amount available for dividends on the preferred stock, if any, and the common stock.

Unsheath the Slide Rule

Those who use the slide rule can now get busy, first to determine the Margin of Profit, which is obtained by dividing the Net Sales into the Net Operating Income, sometimes called the "Net Profit From Operations." The "Profit Margin" for one year does not mean much

unless it is compared with something. If the Profit Margins for a series of years are available, it then can be determined as to whether the trend is up or down. Or a comparison can be made with the Profit Margins of other corporations in the same or similar industries to determine an average level for the profits on sales.

Because of the big bite taken by Federal taxes, it has become popular today to determine the post-tax margin of profit, which is determined by dividing the Net Sales into the Net Income After Federal Taxes. Here again, it is necessary to have comparative post-tax profit margins for previous years or figures for competing companies in the same industry, to draw any intelligent conclusions. This is why one of the primary requisites of a modern annual report is a ten-year table of operating and financial statistics, to make quick comparisons with previous years and determine trends. But far too many corporations fail to provide any of the important ratios, such as profit margins (before or after taxes), operating ratio (percentage of all expenses to net sales or gross income), inventory turnover, working capital ratio (ratio of current assets to current liabilities), and so forth.

Today we are finding plenty of per-share statistics in annual reports, ranging from earnings and dividends per share on the common stock, to Federal taxes and working capital per share. But very few reports provide the percentages paid out in dividends and the amount retained in the business at the end of each year. Over a period of years, the seasoned industrial company should pay out at least 50 per cent of its earnings in dividends. Growth companies often pay dividends of less than 50 per cent, because they are ploughing back a larger share of earnings to pay for expansion, new equipment, and R & D (Research and Development).

But in the back part of the well-balanced annual report, more ratios are needed and there is no apparent reason why these ratios and percentages cannot be supplied, unless the management prefers to exclude them because the trend indicated is not favorable or flattering.

Reports for the Asking

At this point it may be mentioned that if the *Financial World* Annual Report Survey did nothing else, it did encourage thousands of industrial corporations and financial institutions to make their annual reports available to anyone upon request. Today, every person who would like a copy of the annual report of a leading company can obtain one for the asking—often a two-cent postal card is all that is necessary to obtain a copy of a corporate report which is worth around a dollar a copy, and it is sent postpaid.

Read the annual report of the company for which you are working. If it is a publicly owned corporation, that is, with shares in the hands of the public, there will be no difficulty in obtaining a copy. If you work for the subsidiary of a large consolidation, obtain a copy of the annual report of the parent company. Here you will find the management's account of stewardship, its record of progress, and its hopes for the future. There may be some "double-talk" and hedge clauses, but if you work out some of the ratios suggested you can determine whether real progress is being made, or whether there are some problems to be solved. You will be better informed about your company than you were before you read the report.

Obtain copies of the annual reports of all important competitors in your industry. Apply the same ratio tests, and then read what their managements say about the progress of your industry and how they view the future. Opinions from a dozen annual reports, representing the same industry, may cause some confusion, but you will learn why some of your competitors are doing better than your company, while others are having a difficult time. Such matters as overproduction, pricing, shortages, labor difficulties, litigation, and special problems will be revealed in several of the annual reports of your competition. You may know about some of these matters, but the reading of these annual reports will provide a good refresher course on the progress of your industry.

In the Know

Send for copies of the annual reports of all or most of your customer companies or of those leaders of industry who buy the majority of your products. If you are a manufacturer of heavy equipment, this is a simple matter. But if you are in the consumer-goods field, you can at least send for chain store, department store, or mail-order company annual reports. If you are a sales engineer selling equipment, your customer annual reports may very well provide a forecast of capital expenditures for the coming year, as compared with past years, and this will give you a good idea of whether you will sell more or less of your equipment. Customer annual reports also may reveal other factors which may reassure you, or disappoint you, but at least you will be a better salesman and have a broader understanding of your customers' problems and prospects.

Write for copies of the annual reports of your suppliers. If part of your work has to do with purchasing materials and equipment, it will be to your advantage to know if your leading suppliers are prosperous and how large their inventories are. Perhaps these annual reports will indicate future price cuts or increases. In addition, some of these annual reports may disclose new products, which are almost ready for mass distribution, as well as the improvements which have been introduced during the recent past.

Obtain annual reports of companies making substitutes. If you are in the steel industry, perhaps you should send for the annual reports of leading aluminum and copper fabricators, and possibly some of the plastics manufacturers. If you have heard that some new or improved raw material or product has been developed which could prove to be a substitute for something you manufacture, obtain the sales brochure, of course, but also send for the company's annual report.

Watch for annual report advertisements in the financial pages of metropolitan daily newspapers, the financial publications, and the business magazines. Each year more corporations advertise their annual reports and offer copies to the investing public. Many engineers have sent for copies of annual reports for the prime purpose of finding out if they might be good companies to work for, at a time when they are considering a change of job. Annual reports have become highly effective in recruiting engineers, and this is why more managements have devoted a section of the annual report to employees.

When you have your small library of annual reports of different corporations, take out your slide rule and pursue the elusive statistics to determine which of the reports are as good as they look.

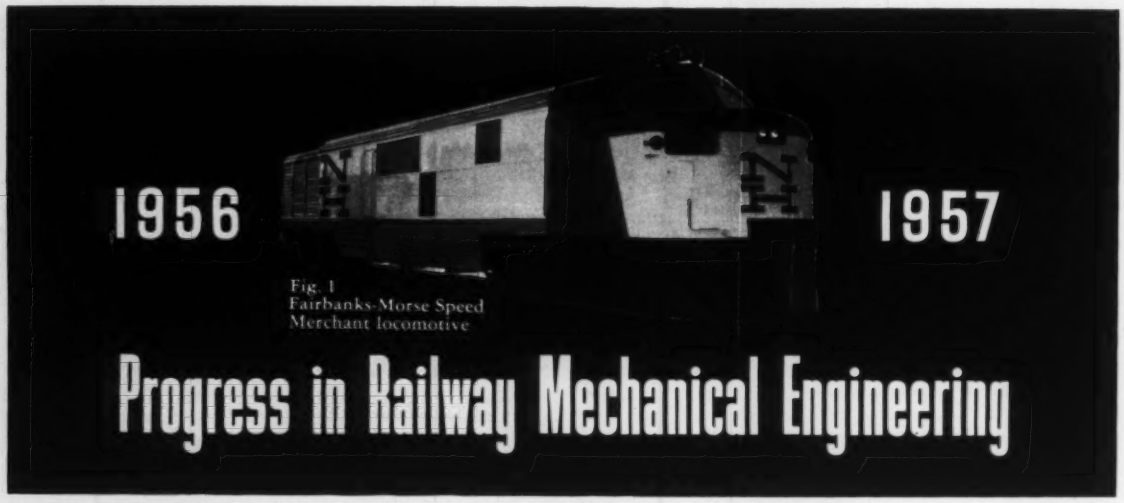


Fig. 1
Fairbanks-Morse Speed
Merchant locomotive

Progress in Railway Mechanical Engineering

MOTIVE-POWER developments reported during the past year did not reveal any new or startling trends, but rather continued progress along lines already established. There was continuing development of the lightweight trains, including dual-powered locomotives for these trains; continued progress in converting to diesel power; and continued development of new types of freight cars.

The distribution of motive-power types in the United States as of August 1, 1957, is shown in Table 1.

Few new types of diesel locomotives were reported. The trend toward standard types of locomotives continues, both in the United States and abroad. Domestic manufacturers continue to use the electric transmission, while some European builders, particularly in Germany, use the hydromechanical transmission.

Renault is building two locomotives of 2400 hp each with free-piston engines and gas-turbine drive, for delivery in 1958.

No new electric locomotives were developed in the United States, but several were reported from Europe.

No definite developments in the field of nuclear-powered locomotives were reported, although this subject continues to receive attention.

Although the production of steam locomotives has been discontinued in the U. S., European builders are continuing their manufacture. For example, Henschel & Sohn report the construction of Beyer-Garratt-type locomotives for the South African Railways, and of 1-C-1 superheated-steam locomotives for the Indian Railways.

Diesel Locomotives

The New Haven Railroad placed in service on its new ACF Talgo trains the Fairbanks-Morse Speed Merchant locomotive. This locomotive, developed especially for use in lightweight train service, is powered by the FM 8-cylinder opposed-piston engine which provides a total of 1720 hp for traction plus auxiliaries. A minimum of 1275 hp is available for traction. This locomotive is provided with third-rail shoes for operation on 600 volts d-c in the electrified zone. Details of the locomotive are given under item 1, Table 2, and the photograph shown in Fig. 1. This locomotive was the subject of a paper presented at the 1956 ASME Annual Meeting (2).[1]

Other locomotives designed for use on the lightweight trains were described in last year's report (3).

General Motors delivered to the New Haven Railroad two standard FL9 units modified for operation on the 600-volt electrified portion of the line. Each locomotive is provided with a pantograph for overhead pickup and also with third-rail shoe pickup. The particulars of this locomotive are shown in Table 2, item 2. Fig. 2 is a photograph of the locomotive.

Another locomotive of General Electric's "Universal Line" of locomotives is shown in Fig. 3, and described in item 3, Table 2. Twenty 1200-hp locomotives of this size have been shipped to the Sorocabana Railroad of Brazil. They feature fabricated equalized trucks in which the bolster is supported on resilient rubber cushions which provide for lateral motion.

A diesel-electric freight locomotive built during the year by Henschel & Sohn of Germany for service in the Netherlands is illustrated in Fig. 4. The locomotive is powered by a single 1425-hp, V-12 General Motors engine. Details are shown in item 4, Table 2.

The French National Railways has taken delivery of an order for 20 road locomotives designed and built by Alsthom for freight-and-passenger service. These units, described in Table 2, item 5, are powered by dual 900-hp diesel engines, and have fabricated trucks. One of

Table 1 Locomotives of Class 1 Railroads of U. S. (1)

	Diesel	Steam	Electric	Gas turbine	Total
Units owned or leased..	26912	3037	611	25	30585
Units stored serviceable	41	832	16	0	889
Units awaiting repair..	1005	550	81	0	1636

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

Report of Committee RR-6 Survey: Chairman, D. R. Meier; members, R. M. Coultas, H. G. McClean, A. G. Dean, F. L. Murphy.

Contributed by the Railroad Division and presented at the Annual Meeting, New York, N. Y., December 1–6, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Paper No. 57—A-232.

NOTE: The survey covers the period September 1, 1956, to September 1, 1957.

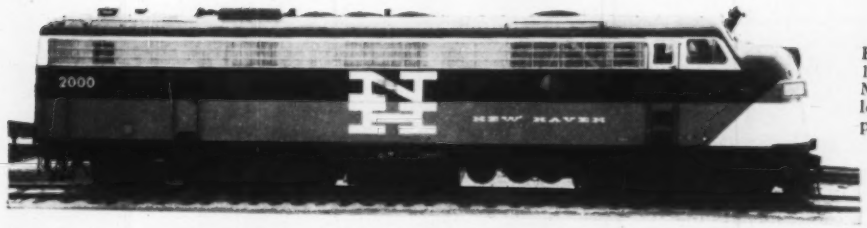


Fig. 2
1750-hp General Motors two-power locomotive for passenger use

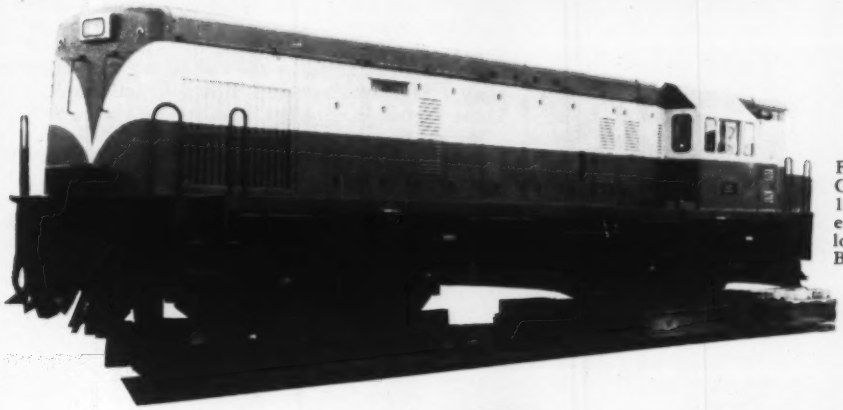


Fig. 3
General Electric 1200-hp diesel-electric locomotive for Brazil

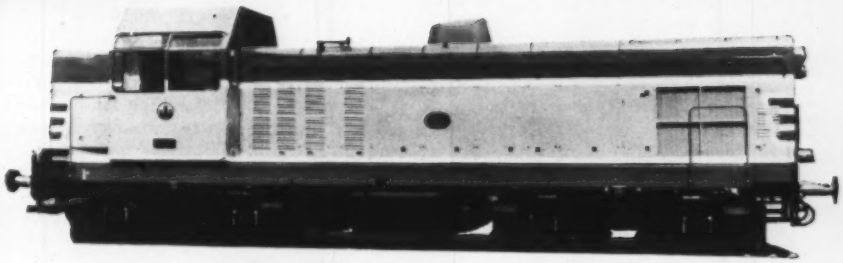


Fig. 4
German-built diesel-electric locomotive for the Netherlands

Fig. 5
Alsthom 1800-hp diesel-electric freight and-passenger locomotive

A review of developments in railroad motive power and rolling stock, both in the United States and abroad

these new diesel-electric units is illustrated in Fig. 5.

A locomotive built for the French National Railways is illustrated in Fig. 6 and described in item 6, Table 2, and is one of an order for 35 diesel-electric units. Each unit is powered by a Sulzer 2000-hp, dual-bank engine, a cross section of which is shown in Fig. 7. This is a C-C, 6-motor locomotive featuring fabricated trucks.

Deutz of Germany has built a center-cab freight locomotive of 2000 hp using two turbosupercharged 2-stroke-cycle diesel engines and hydraulic transmission. A photograph of this locomotive is shown in Fig. 8, and details are provided in item 7, Table 2. The total weight of the locomotive is 75 long tons.

The first of a new standard line of locomotives for the British Railways' modernization program has been built by Vulcan. This line comprises 1000-hp road switchers, details of which are shown in item 8, Table 2. One of these 4-axle, 4-motor diesel-electric units is shown, Fig. 9.

Electric Locomotives

The Elin Electric Corporation of Austria has built a dual-frequency locomotive designed to operate at both $16^2/_3$ and 50 cycles—an indication that the spread of electrification at the industrial frequency points up the desirability of operating through trains in Western Europe. This 2800-hp passenger locomotive is shown in Fig. 10, and its details are outlined in item 1 of Table 3.

A 6000-hp freight locomotive built in Germany for the German Federal Railways is illustrated in Fig. 11. It is the most powerful electric locomotive in service on this system. Particulars of this C-C locomotive are given in item 2, Table 3.

The Swiss Federal Railways has taken delivery of a 5160-hp passenger locomotive built by the Swiss Locomotive and Machine Works, the electrical equipment having been supplied by the Oerlikon Engineering Company. Fig. 12 illustrates this C-C unit, and item 3, Table 3 provides details.

Brown-Boveri has built a 2500-hp, B-B industrial-haulage rectifier locomotive for 6000-volt, 50-cycle a-c operation. The locomotive, illustrated in Fig. 13 and described in item 4, Table 3, is equipped with air-cooled, pumpless excitron rectifiers, and the control is arranged for regenerative (not rheostatic) braking. The unit is equipped for low-speed remote-control operation for train-loading functions.

Freight and Passenger Cars

Numerous developments in the freight-and-passenger-car fields have been described by the press and in trade journals during the past year. This report will be limited to the discussion of the most significant among these. Included among noteworthy developments are the three lightweight passenger trains of the New Haven Railroad, all of which are now in service. Noteworthy, also, are new types of freight equipment embracing several special-

Table 2 Diesel Locomotives

Item No.	1	2	3	4	5	6	7	8
Builder—mechanical	FM	EMD	GE	Henschel	Alsthom	AFL	Deutz	Vulcan
Builder—electrical	GE	EMD	GE	EMD	Alsthom	CEM	—	EE
Owner	NY, NH&H	NY, NH&H	Soro-cabana	Nether-lands	SNCF	SNCF	Deutz	British
Service	P	P	F, P, Sw	F	F-P	F	F	F&P
Wheel arrangement	B-2	B-A1A	B-B	B-B	C-C	C-C	B-B	B-B
Engine data:								
Engines per cab	1	1	1	1	2	1	2	1
Hp rating per engine	1720	1750	1200	1425	900	2000	1000	1000
Number of cylinders	8	V-16	V-8	V-12	V-12	12[b]	V-12	V-8
Bore and stroke, in.	$8^1/_2 \times 10$	$8^1/_2 \times 10$	$9^1/_2 \times 10$	$8^1/_2 \times 10$	6.9×7.3	11×14.2	$7^7/_8 \times 10$	10×12
Engine speed, rpm	850	835	1000	835	1500	710	750	850
Cycles	2	2	4	2	4	4	2	4
Supercharging	No[a]	No[a]	Yes	No[a]	Yes	Yes	Yes	Yes
Manufacturer	FM	EMD	CB	EMD	MGO	Sulzer	Deutz	EE
Weight on drivers, lb	111,000	224,600	158,600	150,000	246,000	264,000	168,000	161,000
Total locomotive weight, lb	216,000	279,000	158,600	150,000	246,000	264,000	168,000	161,000
Fuel capacity, gal	725	1200	800	800	880	1000	660	800
Driving-wheel diameter, in.	40	40	36	$39^3/_8$	$41^1/_2$	$47^1/_2$	41	43
Type of transmission	Elec.	Elec.	Elec.	Elec.	Elec.	Elec.	Hydr.	Elec.
Track gage, in.	$56^1/_2$	$56^1/_2$	$39^3/_8$	$56^1/_2$	$56^1/_2$	$56^1/_2$	$56^1/_2$	$56^1/_2$
Maximum speed, mph	117	89	65	62	81	46	75	75
Fig. no.	1	2	3	4	5	6&7	8	9

[a] Positive displacement blower.
[b] Twin bank vertical cylinders.
F—Freight
P—Passenger
Sw—Switching
FM—Fairbanks, Morse & Company
GE—General Electric Company
Sorocabana—E.F. Sorocabana—Brazil
EMD—Electro-Motive Division of General Motors Corp.
CB—Cooper-Bessemer Corp.
MGO—Société Alsacienne de Construction Mécaniques, France
AFL—Société Ateliers et Forges de la Loire, France
CEM—Cie Electro-Mécanique, France
Sulzer—Cie de Construction Mécanique Procédés Sulzer, Switzerland
Deutz—Klockner-Humboldt-Deutz A.G., Germany
SNCF—French National Railways
EE—English Electric Co., England
Vulcan—Vulcan Foundry Ltd., England
NY, NH&H—New York, New Haven & Hartford R.R.
Henschel—Henschel & Sohn, Germany
British—British Railways

Fig. 6
2000-hp diesel-electric locomotive featuring dual-bank engine

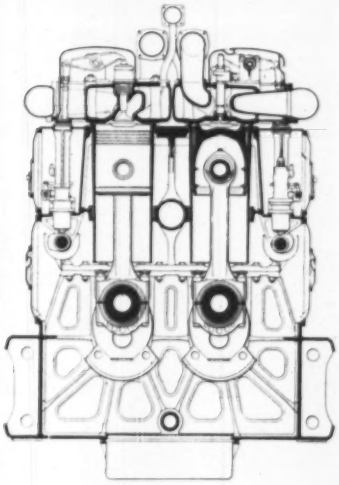


Fig. 7
Cross section of Sulzer 2000-hp dual-bank engine

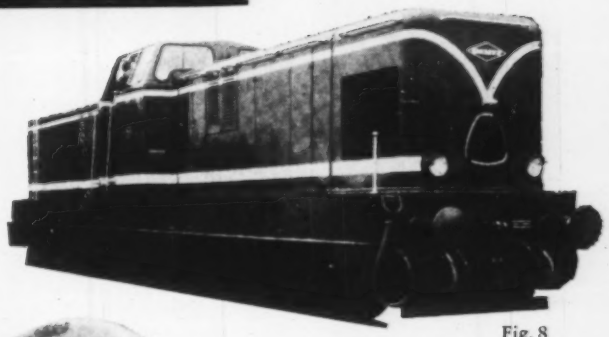


Fig. 8
German-built 2000-hp diesel-hydraulic freight locomotive

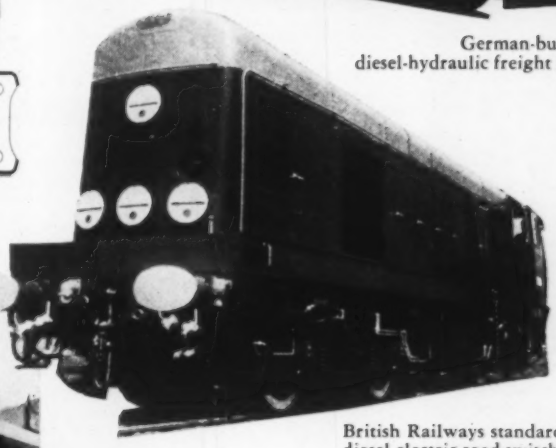


Fig. 9
British Railways standard 1000-hp diesel-electric road switcher

Fig. 10 Austrian 16⅔ and 50 cycle dual frequency electric locomotive

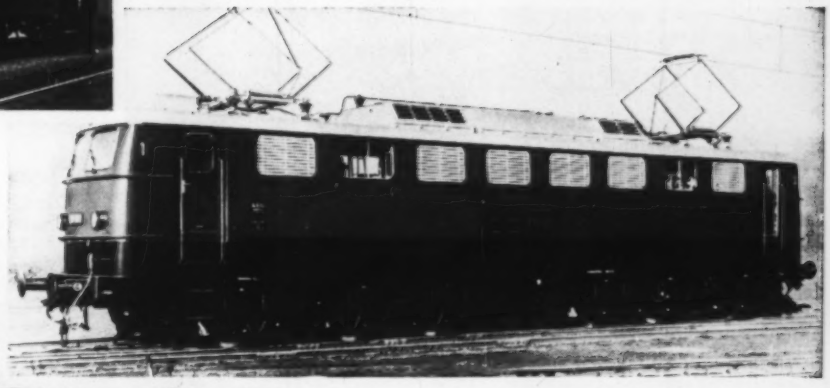


Fig. 11 Krupp-built 15-KV 16⅔ 6000-hp electric freight locomotive

Fig. 12 Swiss Federal Railways 5160-hp passenger locomotive

purpose cars and a number of unusual innovations designed to improve handling and lessen damage to lading. The trend toward the use of air springs in railway cars is increasing in popularity with the introduction of a combination air-coil spring for subway cars.

These and the other developments reported herein represent only a portion of the over-all effort on the part of the railroads and their suppliers to combat the increasing cost of operations, and to place themselves in a more competitive position among the common carriers.

Lightweight Passenger Trains

The term "lightweight" continues to receive emphasis in discussion of new passenger equipment. A number of lightweight high-speed trains are currently undergoing evaluation on several railroads; however, it is too soon to know whether their expected reduced operational and maintenance costs as well as their passenger appeal will be realized.

Of the new passenger trains delivered during the past year, two, namely, "John Quincy Adams" built by ACF, Fig. 14, and New Haven's "Dan'l Webster" built by Pullman Standard, Fig. 15, are near duplicates of the Train "X" and Talgo equipment supplied earlier to other railroads by the same builders and described in previous ASME papers. The primary differences between these trains and their earlier counterparts are additional horsepower in the form of twin locomotives, one at each end

Table 3 Electric Locomotives

Item No.	1	2	3	4
Railroad	Austria	Germany	SFR	Rhine
Builder—mechanical	SGP	Krupp	SLM	KM
Builder—electrical	Elin	AEG	OEC/BBC	BBC
Wheel arrangement	B-B	C-C	C-C	B-B
Service	P	F	P	IH
Power supply	(15 kv 16⅔ cps)[a] (20 kv 50 cps)	15 kv 16⅔ cps	15 kv 16⅔ cps	6 kv 50 cps
Power conversion	AC series motors	AC series motor	AC series motor	Excitron rec.
Current collector	Panto.	Panto.	Panto.	Panto.
Driving wheels:				
Number	8	12	12	8
Diameter, in.	53	49.2	49.6	44
Weight, lb:				
Total	180,000	273,000	264,000	290,000
On drivers	180,000	273,000	264,000	290,000
Per driving axle	45,000	45,500	44,000	72,500
Dimensions, ft-in.:				
Length over-all	50-0	63-9½	60-5	54-2
Width over-all	10-0	10-2½	9-8	—
Height, panto down	15-0	14-5	14-9	—
Rigid wheel base	10-6	14-7	—	—
Total wheel base	35-0	43-7	42-8	—
Traction motors:				
Number	4	6	6	4
Method of mounting	Truck	Axle hung	Truck	Axle hung
Method of drive	Resilient	Gear	Resilient	Gear
Gear ratio	3.625	3.727	2.56	—
Tractive force, lb:				
One-hour rating	20,000	46,400	46,700	48,600
Per cent adhesion	11.1	16.9	17.7	16.8
Continuous rating	15,850	44,500	39,700	—
Per cent adhesion	8.8	16.3	15.0	—
Rail horsepower:				
One-hour rating	2800	6000	5740	2500
Continuous rating	2620	5900	5160	2500
Maximum	—	—	—	—
Speed, mph:				
One-hour rating	51	48.5	46	19.2
Continuous rating	62	49.6	48.8	—
Maximum	68.5	62	77.7	43.5
Regeneration	—	No	Yes	Yes
Multiple-unit operation	—	No	No	—
Track gage, in.	56½	56½	56½	56½
Fig. no.	10	11	12	13

[a] Dual frequency locomotive.
P—Passenger
F—Freight
IH—Industrial haulage
Austria—Austrian Federal Railways
SGP—Simmering-Graz-Pauker AG, Austria
Elin—Elin AG, Austria
Germany—German Federal Railways
AEG—Allgemeine Elektrizitäts Gesellschaft Germany
SFR—Swiss Federal Railways
SLM—Swiss Locomotive & Machine Works, Switzerland
OEC—Oerlikon Engineering Company, Switzerland
BBC—Brown, Boveri & Co., Switzerland
Rhine—Rhineland opencast lignite mines (Rhein AG), Germany
KM—Krauss-Maffei Locomotive Works, Germany

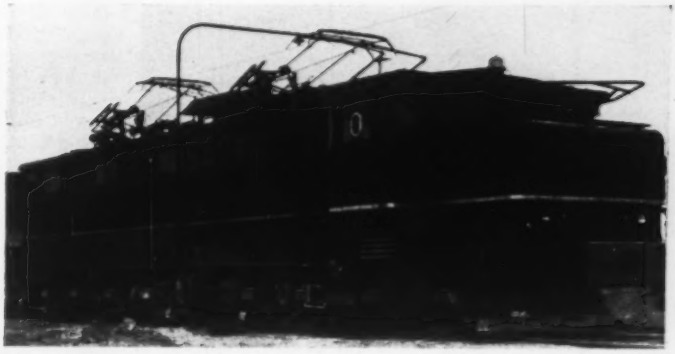


Fig. 13
Brown-Boveri
6000-volt
2500-hp
rectifier-
type locomotive

Fig. 14
ACF-built train with
Fairbanks-Morse
two-power
locomotive

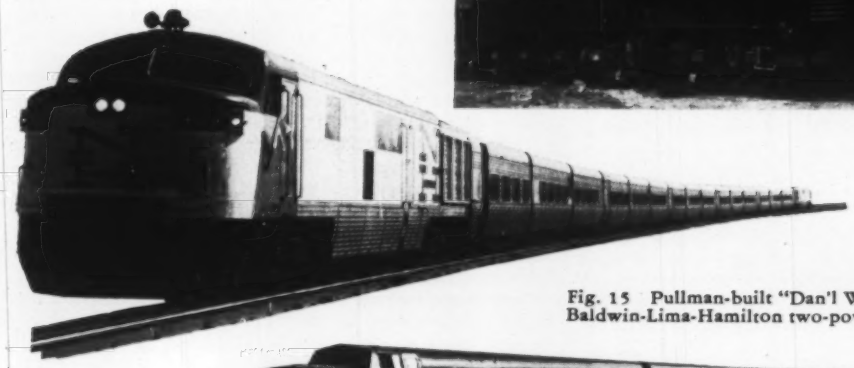
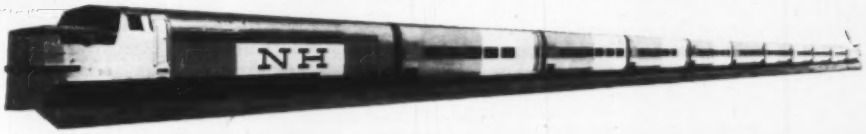


Fig. 15 Pullman-built "Dan'l Webster" train with Baldwin-Lima-Hamilton two-power locomotive



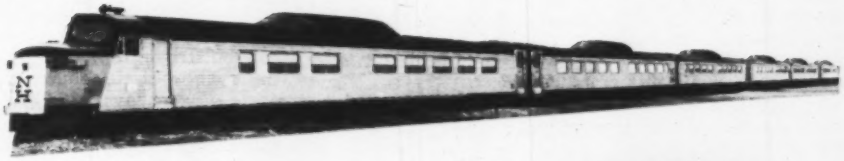


Fig. 16
New Haven's
"Roger Williams,"
Budd-built
two-power train

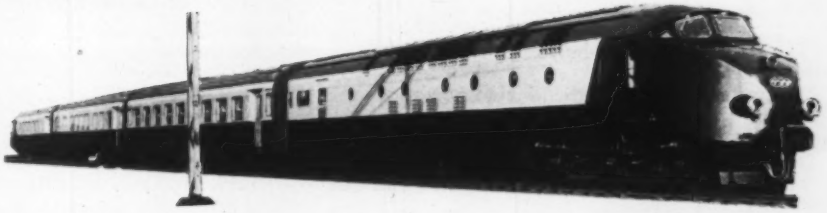


Fig. 17
Trans-Europe express
train with 2300-hp
Netherlands-built diesel-
electric power car

Fig. 18 Budd-built siesta coach has 24 single and 8 double rooms

Fig. 19 The single rooms of the siesta coach are arranged in duplex fashion

of the train, and their ability to operate on 600-volt, d-c power drawn from a third rail.

New Haven's third lightweight coach train, the Budd-built "Roger Williams," Fig. 16, is an outgrowth of the builder's experience with the RDC. Mechanically similar to the self-propelled car, this train has been tailored to high-speed and rapid turn-around by the use of end cars with an engineer's cab at one end, and by gearing for greater speeds compatible with power available in a multiple-unit train. Outside-swing-hanger trucks are used. Traction motors and control to permit operation into Grand Central Station were furnished by the General Electric Company. Over-all height has been reduced to save weight and provide a low silhouette. Interior paneling is vinyl-faced, using color combinations selected to produce a pleasing atmosphere.

The pertinent features of these three trains are shown in Table 4.

Seven countries in Europe—Belgium, France, Germany, Italy, Luxembourg, the Netherlands, and Switzerland—are participating in sponsoring an improved international passenger service. This service, called "Trans Europe Express," makes use of new trains constructed by various builders in France, Holland, Switzerland, and Germany. A train set built by N. V. Nederlandsche Spooswegen, consisting of a diesel-electric power car and three tailers, is shown in Fig. 17. Five such trains, the motor coaches of which were built in the Netherlands, and the trailers in Switzerland, will be operated on common account by the Railways of the two countries. Electrical equipment is Brown-Boveri.

The truck is of swing-bolster construction, with axle arrangement A-1-A.

The weight of these trains, including motor coach, is 226 long tons, and their capacity 114 passengers, plus space for 32 in the dining car.

The motor coach has two Werkspoor 16-cylinder engines of 1000-hp each at 1400 rpm. Maximum scheduled speed is 87 mph.

Other similar trains built in Germany will use hydraulic transmissions and a different make of diesel engine (4).

An interesting development in the field of lightweight trains is taking place in Sweden (5). Three experimental coaches for an ultimate 10-car, 265-seat train have been built for the Swedish State Railways. These cars are designed to weigh 495 lb per passenger seat, without locomotive, or considerably less than the American lightweight trains. The cars are basically of tubular steel-sheet construction, 37 ft long, and 10 ft 2 in. in both width and height.

A feature of these cars is the use of nonrotatable steerable axles on which the wheels are free. The front axle of one car is coupled to the rear axle of another car to form a sort of 4-wheel truck which is said to automatically adjust itself to curves. Air-brake and electrical connections are built into the coupling. The coupling arrangement used makes it possible to cut cars in and out of the consist as desired.

It is estimated that a 1400-hp locomotive for this train can be built within 78,000-lb weight, and that this will provide sufficient power for the locomotive to reach speeds of 93 mph.

Siesta Car. Budd's Siesta coach, a car of conventional size and weight in operation on Burlington's new Denver Zephyr, represents a new concept of sleeping-car travel, Figs. 18 and 19. Possessing facilities for sleeping forty passengers in 24 single and 8 double rooms, the car was designed to attract overnight passengers at a fare only slightly more than the coach rate. Each room has its own toilet and lavatory as well as individual heat and air-conditioning controls. Extensive use is made of polyester plastic shells, with the assembly of two mating units forming an entire room exclusive of trim. The single rooms are arranged in duplex fashion with upper rooms interlacing the lower. The 74-in. berth is formed by two half sections folding out of opposite partitions, except for the upper berth in the double room which folds down from the overhead.

Lightweight Multiple Unit Car. The Budd Company has under construction for the Pennsylvania Railroad six electric multiple-unit cars of lightweight Pioneer III construction. These cars will operate from the 11,000-volt line, using ignitron rectifiers and d-c motors. Electric equipment is to be furnished by the Westinghouse Company.

Subway Car Truck. Pullman-Standard is delivering to the Metropolitan Transit Authority of Boston a quantity of 2-car-unit rapid-transit cars, Fig. 20. Of unusual interest is the truck, supplied by General Steel Castings Corporation, which incorporates a combination-air-and-coil bolster spring, Fig. 21. The coil spring supports the weight of the empty car while the air spring supports the passenger weight differential.

The truck is equipped with two General Electric motors mounted longitudinally, and driving through right-angle hypoid gears. Dynamic braking is provided down to 5 mph, and the control is arranged to blend the dynamic and air brakes at low speed. Air brakes are the Westinghouse Air Brake Company's package brake with the Cobra shoe.

French Pendulum Car. The French Railways are testing a lightweight "pendulum" car designed to operate at average speeds in excess of 100 mph. The height of the horizontal axis of oscillation is 5 ft 9 in. above the track, whereas the center of gravity of the body is approximately 28 in. below this axis. It is intended that the car will "bank" into curves, and allow speeds on curved track which heretofore resulted in severe passenger discomfort. The body of the car itself is made of a light alloy, argon welded. The weight of the car, including equipment, is approximately 57 metric tons (125,700 lb). The coach is shown in Fig. 22 (6).

Baggage Express Cars. ACF Industries is building for several railroads a low-cost baggage-express car, designed for mass production. The cars are 70 ft $^1/_2$ in. long, and have a capacity of 70,000 lb. They may be equipped with messenger facilities at a minimum expense. The cars are manufactured in the builder's freight-car shops using freight-car methods, thus further reducing costs. One of these low-cost baggage-express cars is shown in Fig. 23.

Fig. 20
Pullman-built rapid-transit cars for Boston

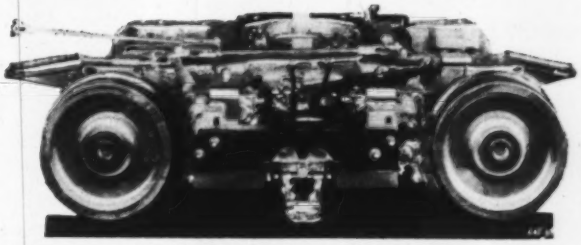


Fig. 21 Truck used on rapid-transit incorporates a combination-air-and-coil bolster spring

Fig. 22
French National Railways lightweight "pendulum" car

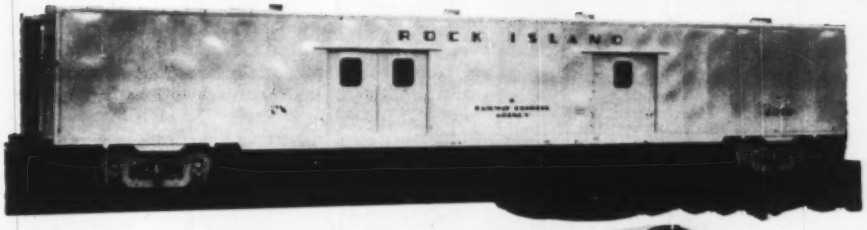


Fig. 23
ACF-built low-cost baggage-express car designed for mass production

Fig. 24
Car designed by Evans Products Co. to transport steel coils up to 7 ft in diameter

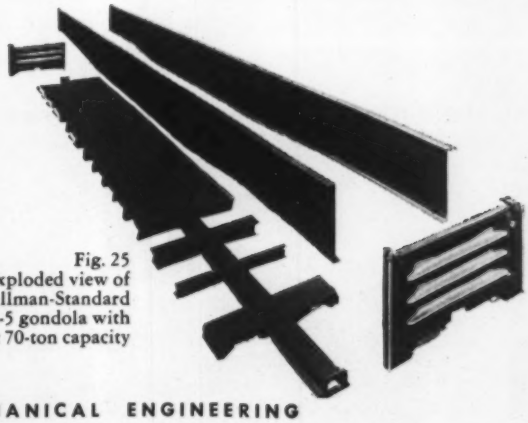


Fig. 25
Exploded view of Pullman-Standard PS-5 gondola with basic 70-ton capacity

Fig. 26
70-ton pulpwood car, only 2 ft higher than 50-ton predecessor

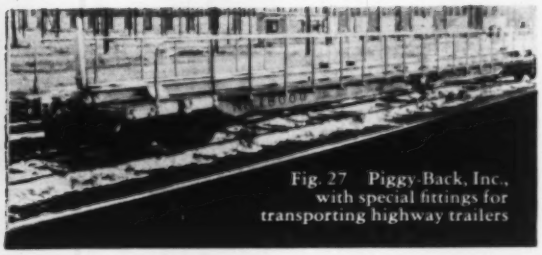


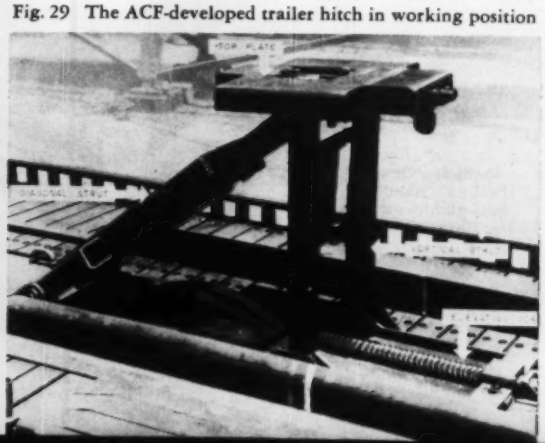
Fig. 27 Piggy-Back, Inc., with special fittings for transporting highway trailers

Table 4 Comparison of Lightweight Trains of New Haven Railroad

	Pullman train	ACF Talgo	Budd-modified RDC
Train consist	1 center-unit grill 5 2-unit articulated coaches	1 3-unit coach grill (articulated) 4 3-unit coaches (articulated)	2 head-end coaches 3 intermediate coaches 1 intermediate coach-grill
Length of each car; ft, in.	2-unit articulated coach, 99-3 Center unit grill, 48-0	109-5 1/2	85-0
Length of entire train including locomotives; ft, in.	667-3 1/2	562-6	508-6
Height, over-all; ft, in.	11-0	10-10 1/4	12-5 5/8
Width, over-all; ft, in.	10-0	10-2	10-0
Floor height, in.	23 5/8	26 5/32	51 5/8
Center of gravity above rail, in.	44	42	51
Wheel diameter, in.	28	28	34
Number of axles per coach	Center, 2 2-unit articulated, 2	4	4
Seat centers, in.	39	38	40
Number of seats per coach	Center, 31 Articulated, 88	94	Intermediate, 76 Head end, 60
Total seating capacity	Coach, 352 Dining, 31	Coach, 428 Dining, 39	Coach, 376 Dining, 40
Total weight of train (including locomotives) light, lb	611,434	809,346	798,000
Weight per seat (including locomotives), lb	1597	1733	1918
Weight per traction horsepower, lb	340	372	261
Car-body suspension	Self-leveling air springs	Coil springs	Coil springs
Coupler type	W.A.B.Co. load-carrying type	Ohio Brass Co. tight lock	AAR type-H tight lock
Auxiliary power	480-volt 3-phase, 60-cycle from locomotives	440-volt, 3-phase, 60-cycle from locomotives	2 22.5-kw engine-driven genemotors per car
Air conditioning	Locker-sealed type each car. 6-ton charged with F-12	2 Trane 4.5-ton units per 3-unit coach	1 Frigidaire 8-ton unit per coach
Heating	Overhead and floor resistance type (electric)	Overhead and floor resistance type (electric)	Engine cooling water
Brake	N.Y. Air Brake "LWE" electro-pneumatic-actuated single-cobra shoe tread	W.A.B. Co. E26 pneumatic actuated single cobra shoe tread	W.A.B. Co. H.S.C. electropneumatic double shoe disk type
Public-address system	RCA system in ceiling panels	Bogen system	None

Fig. 28 The ACF-developed trailer hitch in retracted position

Fig. 29 The ACF-developed trailer hitch in working position



Freight Cars

Several new freight-car types, continuing the emphasis on the special-purpose car, have made their appearance during the past year. Evans Products Company has developed a coil car designed to transport steel coils up to 7 ft in diam protected from weather, load shifting, and impact damage. Two cylindrical metal containers, split down the center, and capable of being cranked open, are mounted on a conventional flat car, Fig. 24. Inside, the coils are held in position by adjustable wood-cushioned steel cross members, sprung to absorb shock. Vertical shutter-type doors located on the ends of the containers allow entry into the car without opening the shell.

Pullman-Standard has added a fifth member to its family of standardized freight cars. The PS-5 gondola car is available in both the 52 ft 6 in. and 65 ft 6 in. lengths with basic 70-ton capacity, with wood or steel floors, and fixed or drop ends. Fig. 25 shows an exploded view of the car construction.

General Steel Castings Corporation is supplying cast-steel underframes, and cast, interlocking, upright bulkheads for 70-ton pulpwood cars, Fig. 26. These cars, an outgrowth of the 50-ton-capacity types, have the same over-all length but are 2 ft higher than their predecessor. Five of these cars have the capacity of seven of the earlier type.

The Pennsylvania Railroad, in an effort to improve shock absorption and distribution in freight cars, is building, at its Samuel Rea shops, a series of boxcars incorporating diagonal cross-bearers in the underframe. These members are designed to transfer loads to the side sills at areas where the full strength of the car can be utilized.

The movement of highway trailers on flatcars continues to increase as new handling methods are introduced. In the Piggy-Back, Inc., standard car, Fig. 27, various types of devices to secure the trailer to the flatcar, including the ACF hitch fastened directly to the flatcar, Figs. 28 and 29; and the Piggy-Back, Inc., dolly attached to the trailer axles, Fig. 30, and developed for use in conjunction with the Piggy-Back standard car, are examples of some of the more noteworthy developments in this field.

Brake "X" developed by Buffalo Brake Beam Company is a single-plate disk brake for freight cars, designed to use standard AAR brake cylinders and hand brakes, Fig. 31. Force from the cylinders is picked up at the truck by a linkage which equalizes the brake pressure to all wheels. This pressure is applied, through a face plate, to the brake blocks and disks, mounted on the wheel hubs. Brake "X" can be adapted to give any deceleration rate required for the particular type service by adjusting cylinder-lever linkage.

Southern Pacific, in conjunction with Stanford Research Institute, has developed an impact-absorbing underframe for freight cars using a hydraulic device to adjust cushioning. The hydraulic device consists of interleafed friction plates, one set attached to the car body, the other set to a floating draft sill which, in turn, is fixed to the draft gear. Friction between the plates is controlled by a hydraulic piston which is activated by an inclined plane, also attached to the draft sill. The major advantage derived from this arrangement is that cushioning is adjusted to speed and severity of impact, and is not proportional to travel.

Great Northern has recently completed several 40-ft boxcars equipped with 6-ft plug doors, similar to the type used on refrigerator cars, in addition to the conventional sliding door. The combination of these doors makes a 12-ft opening in the car side. The car may be converted for single-door use by closing the plug door; its flush inside surface then becomes an integral part of the car side.

New York Central Transport Company, a subsidiary of the New York Central Railroad, has developed a version of the piggyback service which it calls "Flexi-Van." This arrangement is essentially a highway trailer which may be detached from its running gear and placed on a specially built flatcar. In this operation, the trailer is backed up at right angles to the flatcar. The trailer body is then slid from its running gear onto a turntable on the flatcar. Finally, the trailer body is rotated parallel to the center line of the car and locked into position. At its destination, the loading procedure is reversed and the trailer is moved off the flatcar and onto another set of highway running gear for hauling to its final delivery point.

Acknowledgments

The Committee on Survey acknowledges with deep appreciation the assistance in procuring material for the report given by *Railway Age*, *Modern Railroads*, *The Railway Gazette*, *Diesel Railway Traction*, *The Locomotive*, *Railway Progress;* and by the railroads, locomotive and car builders, and equipment suppliers who so generously furnished much of the information used for compiling the report.

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5 *Railway Progress*, vol. 11, January, 1957, p. 21.
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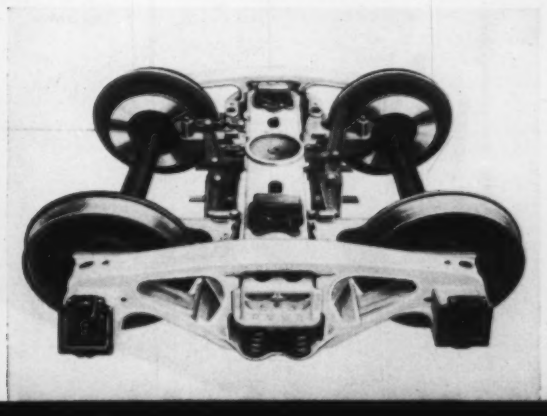
Fig. 30 Dolly for use in conjunction with Piggy-Back, Inc., car

Fig. 31 Freight car truck equipped with single-plate brake "X"



Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Assistant Editor

BRIEFING THE RECORD

Explorer

THE United States' first earth satellite, the "Explorer," was launched from Cape Canaveral, Fla., on January 31, by means of a modified Jupiter-C test vehicle.

The satellite and final-stage rocket were designed to remain together and circle the earth as one unit. The satellite was not designed to be recovered. Invisible to the naked eye, it will have the brilliance of a fifth to sixth magnitude star.

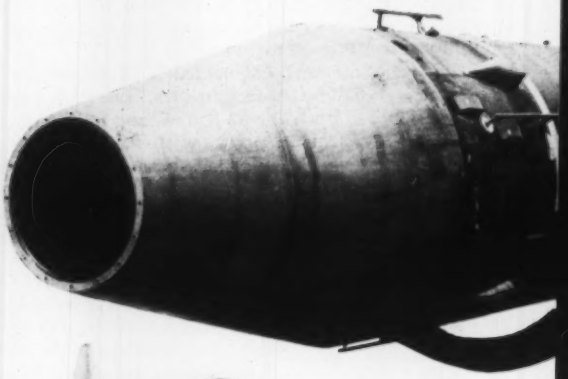
The first stage was a product of the Army Ballistic Missile Agency and was powered by the proved Redstone ballistic missile engine, a liquid-propellant power plant. The upper stages were solid-propellant rockets furnished by the Jet Propulsion Laboratory of California Institute of Technology.

According to the Department of Defense, the Jupiter-C was approximately 70 ft long. The final stage, plus the pointed cylindrical satellite case containing the scientific instruments, is 80 in. long and has a nominal diameter of 6 in.

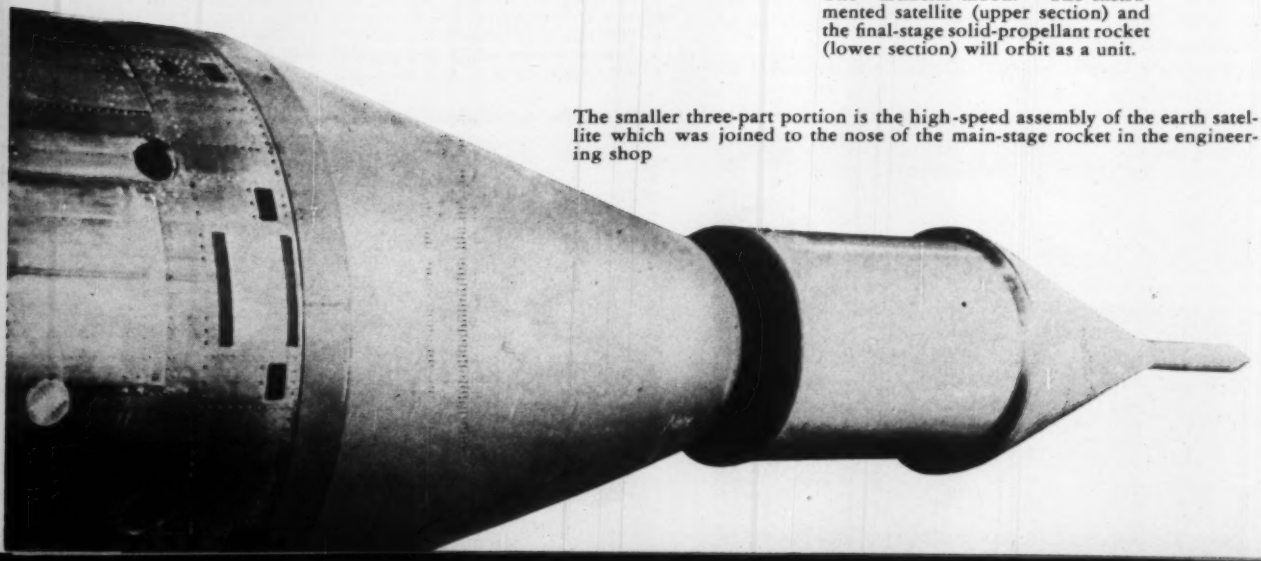
Weight of the satellite proper was 18.13 lb; of the final stage, 12.67 lb after burnout; total weight of the satellite, 30.80 lb. Payload instruments weigh about 11 lb, exclusive of protecting steel case, which weighs 7.5 lb.

Instrumentation and telemetry are designed to gather and transmit four types of information—skin temperature, internal temperature, cosmic-dust erosion, and cosmic-ray data. The main part of the package is a cosmic-radiation experiment with a Geiger-Mueller counter.

Data are to be dispatched continuously by two



The "artificial moon." The instrumented satellite (upper section) and the final-stage solid-propellant rocket (lower section) will orbit as a unit.



The smaller three-part portion is the high-speed assembly of the earth satellite which was joined to the nose of the main-stage rocket in the engineering shop

Top photo. The main-stage booster and nose section of the modified Jupiter-C were joined at the U. S. Army Ballistic Missile Agency shops. The "Explorer" was completed by adding the high-speed assembly shown on opposite page.

Bottom photo. Inspecting the finished Fiberglas "lattice sleeve" that holds the interior instruments of the satellite. The other objects are the thin steel case into which the sleeve fits, and nose cone of the satellite.

transmitters. One operating at 60 milliwatts on 108.00 megacycles is expected to operate for a period of two to three weeks. The second which operates at 10 milliwatts on 108.03 megacycles had a predicted life of two to three months. Amateurs would probably be able to receive signals from the first but not the second transmitter.

The nose cone, which was of the type displayed by the President on his recent nation-wide TV address, came from a Jupiter-C re-entry experiment that was entirely successful. It was produced by Lodge and Shipley of Cincinnati, Ohio. The first-stage power plant was made by Rocketdyne Division, North American Aviation Company of Canoga Park, Calif. Most guidance and control components were supplied by the Ford Instrument Company of Garden City, N. Y. Launcher base for the second stage was by the Reynolds Metals Company of Sheffield, Ala.

Thermonuclear Power

THE declassification of a large body of information on thermonuclear research makes some background on thermonuclear theory desirable, although the generation of power by this means is still a great many years away.

The basic requirements for achieving nuclear fusion have been outlined in articles in the *Scientific American* by Richard F. Post, physicist at the University of California Radiation Laboratory, and in *Engineering* by A. A. Ware, in charge of thermonuclear work at the British Research Laboratory of Associated Electrical Industries Limited.

To achieve a self-sustaining fusion reaction, temperatures of from 100 to 350 million degrees C are required. Matter at this temperature becomes a "plasma" of electrically charged nuclei (deuterons) and electrons.

Basic natural raw material is deuterium, with the by-products tritium and helium-3 also probable fuels. Although deuterium is a rare isotope occurring in the ratio of about 2 parts in 10,000 of natural hydrogen, there is an almost unlimited quantity in the sea.

Because nuclei of elements above hydrogen and helium in the periodic table accelerate the loss of heat through radiation, the plasma for a fusion reaction must have a high degree of purity from these elements. A closed chamber is needed to keep out the atmosphere and maintain a low density, but the plasma must not be allowed to touch the walls since contact would instantly cool the plasma and quench the reaction. This is largely because of the low density—1/10,000 of an atmosphere—at which the plasma must be kept for the energy output and pressure of the gas to remain within controllable bounds.

To keep the plasma away from the walls, the "pinch effect" has been experimented with. This utilizes a magnetic field created by passing a current of millions of amperes through the plasma. The magnetic field tends to pinch the plasma and pull it away from the container walls. Unfortunately, "kinks" develop and the pinched column tends to constrict unevenly or to "wobble" increasingly until it touches the walls anyway. Theoretically, it may be possible to achieve stabilization by creating a second or "stiffening" magnetic field to prevent this.

In January, the AEC announced that both American and British experimeters have succeeded in producing and maintaining quite high temperatures in a plasma of light nuclei, and the containment of such plasma for brief, but nevertheless agreeable, lengths of time. The question of the achievement of neutrons from thermonuclear reactions (MECHANICAL ENGINEERING, December, 1957, p. 1154) still awaits experimental confirmation.

Temperatures reached by the British in the Zero-Energy Thermonuclear Assembly, ZETA, at Harwell have been as high as 5 million deg C, higher than the measured surface temperature of any star.

On August 30, 1957, this apparatus was first operated under conditions that produced nuclear reactions; neutrons emitted in these reactions were observed when deuterium gas was heated electrically to temperatures in the region from 2 to 5 million C. The hot gas was isolated from the walls for periods of 2 to 5 thousandths of a second. The heating process was repeated every 10 sec. The high temperatures achieved, together with the relatively long duration for which the hot gas has been isolated from the tube walls, are the most important

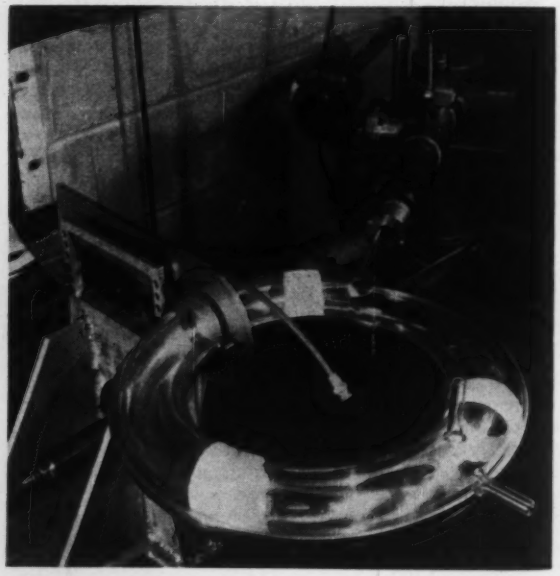
The main condenser bank of Columbus II at Los Alamos, N. Mex., which is a high-powered straight pinch tube, was designed for the current to reach maximum value quickly

experimental results obtained so far. While much longer times—perhaps several seconds—are required for a useful power output, there appears to be no fundamental reason why these longer times, together with much higher temperatures, cannot be achieved.

In the ZETA apparatus the number of neutrons produced by each pulse of energy as the current was doubled was roughly that which might be expected from a thermonuclear reaction at the measured temperatures. These temperatures have been definitely established.

In ZETA the discharge chamber is a ring-shaped tube or torus of 1 meter bore and 3 meters mean diameter, containing deuterium gas at low pressure. The tube is encircled over part of its length by the iron core of a pulse transformer. A large electric current is passed through the deuterium gas which heats it and also produces an intense magnetic field around the column of hot gas. Peak currents up to 200,000 amp have been passed through the ionized gas for periods up to 5 millisec. The current pulse is repeated every 10 sec. Emission of neutrons throughout the current pulse is observed regularly in routine operation of ZETA with deuterium; there are up to 3 million neutrons emitted per pulse.

Perhapsatron S-3 at Los Alamos serves as a gastight glass "doughnut" container for the deuterium gas used in recent fusion experiments



American researchers have succeeded in producing temperatures as high as 6 million C and have maintained these temperatures for a few millionths of a second. Large numbers of neutrons have been produced in these experiments, between a million and 100 million neutrons per pulse. An apparatus called Columbus II is a straight pinch tube fed by a 14-ft-diam ring of 25 special condensers hooked in parallel. Elaborate tests were undertaken to determine photographically the origin of the neutrons. Results determined that the neutrons are emitted from the gas and come practically uniformly from all parts of the tube, except an area near the positive electrode, as expected. But there are two possible explanations, so that the question of thermonuclear origin is still not settled.

Another American straight pinch tube, called Columbus S-4, is a 5-in-diam 24-in-long porcelain cylinder constructed to study the effect of increased tube diameter and interelectrode spacing.

An American doughnut-shaped apparatus called Perhapsatron S-3 came into operation in December, 1957, and results suggest that a well-stabilized discharge has been achieved with it.

The magnetic pinch effect was predicted theoretically in 1934 by Willard Bennett, now at the Naval Research Laboratory. "To the best of our (the AEC's) knowledge," the first clear experimental proof of the effect was supplied in 1951 by Dr. Ware (the author of the *Engineering* article).

Methods of harnessing thermonuclear power are even further in the realm of theory. Direct generation of electricity may be possible, eliminating the inefficiency of the steam-generating methods applied with fossil-fuel and fission power.

Although the technical difficulties are formidable, their solution offers an almost unlimited source of energy. There is enough deuterium in the sea to supply the world's power at a thousand times the present rate for a million years. By contrast, the U. S. has used one half of its coal resources since 1920, and although fission will offer abundant power by comparison, it would probably get us only part way through the next century.

Carbon-Monoxide-Fired Boiler

A $1,250,000 carbon-monoxide-fired boiler of sufficient capacity to service the normal needs of an oil refinery is being erected at the new multimillion-dollar Toledo, Ohio, refinery of the Standard Oil Company (Ohio).

The huge unit, which is to meet the rigorous uninterrupted steam demands of the entire refinery, has been designed to produce a total of 450,000 lb per hr of steam, the greatest capacity for any CO boiler yet constructed. A supplemental medium-sized B&W power boiler fired with conventional gas is also being erected to meet peak demands.

The "heart" of the refinery is Sohio's new fluid catalytic-cracking unit, which has been designed to include the CO boiler as an integral part. From the heat

it recovers and the combustion which takes place in the boiler, it will produce 200 million Btu of heat per hr from the high-temperature gases produced by the "cat cracker."

It is expected to pay for itself within the relatively short period of three years or less.

Among the many refinery processes which will utilize the steam delivered by the boiler are: atmospheric and vacuum crude-oil distillation, delayed coking, catalytic cracking, polymerization and reforming, hydrogenation, gasoline recovery and stabilization, and continuous gasoline treating and blending.

Scheduled for completion during the summer of 1958, the new refinery will increase the capacity of Sohio's Toledo operation to 60,000 bbl of oil during each full operating day and will put all but two alkylation units and a rerun unit of the present refinery "in moth balls." This is an increase of 31,000 bbl over present capacity.

Ultrasonic Welder

UTILIZING ultrasonic vibrations, Gulton Industries, Metuchen, N. J., have produced what is believed to be the first automatically operated continuous-seam ultrasonic welder. Through high-frequency sound alone, two pieces of metal are joined as a result of a molecular transference or plastic flow at the interfaces of the two metals and below the melting point of either metal. The exact metallography is unknown, but the welds produced possess the standard characteristics of having greater strength than the material of either of the two pieces which they join.

The continuous-seam ultrasonic welder joins aluminum to aluminum, aluminum to stainless steel, or any two similar or dissimilar metals. It will weld metal foil up to 0.080 in., and down to fine foil, to a base metal of any kind and thickness.

The prototype model, which is similar in performance to standard electric seam welders, achieves a welding speed of 200 in. per min. This is accomplished with aluminum, which could not be heat-welded because of the accumulation of oxide which builds up under heating.

The machine was developed as a result of a research contract and built to exact specifications for use in a classified project. It simultaneously welds two rolls of corrugated aluminum foil, seam by seam, to the top and bottom surfaces of semicircular sheets of extruded honeycomb aluminum that is 30 in. wide. It is capable of welding 11 different radii without modification.

The 13-ft-high, 12-ft-long, and 10-ft-wide machine weighs roughly 3 tons, is powered by two 2-kw generators which operate alternately, depending on the forward or backward motion of the welding heads, and which supply 500 watts of power to each welding head.

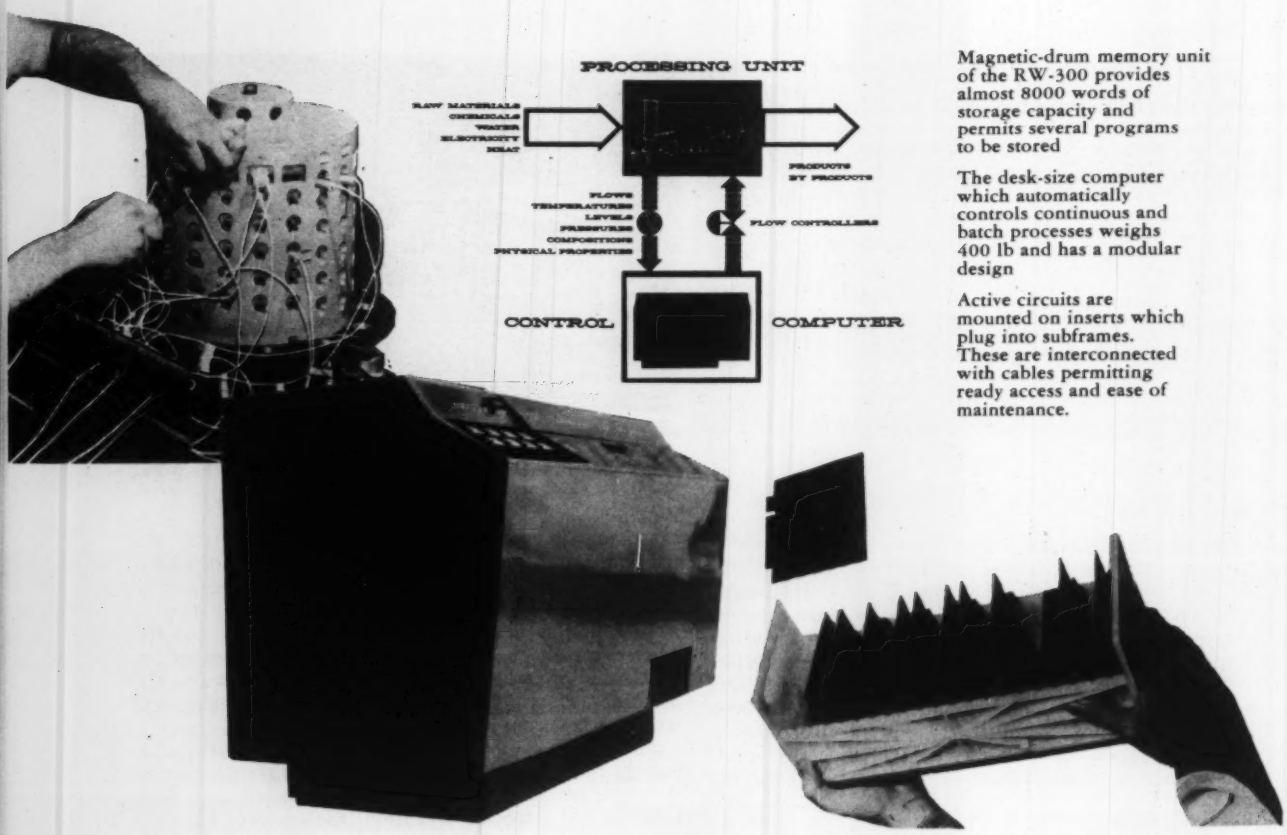
There are eight ultrasonically driven welding heads operating approximately in the 20,000-cycle range. Each head has four barium-titanate transducers epoxy-attached to a solid metal "horn" which serves as a mechanical step-up transformer converting small vibrations to larger ones. Horns must be replaced if the frequency is to be varied. A carbide-tipped tool-steel strip at the end of the cone transmits shear waves down the welding tool which is in contact with the metal at only 25 psi. This is too light a pressure to cause any deformation with conventional metals, and the temperature rises only to the boiling point of water.

High-frequency sound alone welds corrugated aluminum to a honeycomb-aluminum base. Individual welding tools are at the apex of the metal "horns" above and below the work.

A pair of welding heads above the work operates in alternate seams in one direction at the same time a similar pair is in operation below the piece. On the reverse travel, the other two pairs are in operation. At the end of each round trip for the welding heads, the machine indexes, moving the assemblage to the next working position, and repeating the cycle.

The machine is a self-monitoring instrument, constantly checking itself against failure and shutting down if failure occurs. Panel lights locate a defective part. Once set for a specific operation, the operator has only to stack the sheets or pieces to be welded, turn on the machine, and finally remove the finished work.

Paired transducer welding heads follow alternate channels, welding 200 in. of continuous seam per min and indexing for the next rows at the end of the channel



Magnetic-drum memory unit of the RW-300 provides almost 8000 words of storage capacity and permits several programs to be stored

The desk-size computer which automatically controls continuous and batch processes weighs 400 lb and has a modular design

Active circuits are mounted on inserts which plug into subframes. These are interconnected with cables permitting ready access and ease of maintenance.

Digital Process Control

The first digital computer engineered specifically for fully automatic control of industrial processes, for data logging, and for test-facility operation, is designated the RW-300 by the manufacturer, the Ramo-Wooldridge Corporation, Los Angeles, Calif.

It brings a new degree of automatic control and efficiency to continuous processes employed in such industries as petroleum refining, petrochemicals, chemicals, metals, glass, food, and paper. An operator's control unit provides computer start and stop, program load, program start and stop.

The first RW-300 installation is now under way at the Texas Company's Port Arthur, Texas, petroleum refinery, where it will control catalyst polymerization.

The RW-300 automatically controls continuous and batch processes by adjusting controllable variables in order to compensate for changes in independent and uncontrollable variables. Connected directly to measuring instruments and control devices, the computer receives analog signals from these instruments and converts them to digital form. After calculations are performed, the digital control signals are converted to analog form and transmitted to controllers and other control devices. The RW-300 can handle more than 500 analog inputs and more than 100 analog outputs.

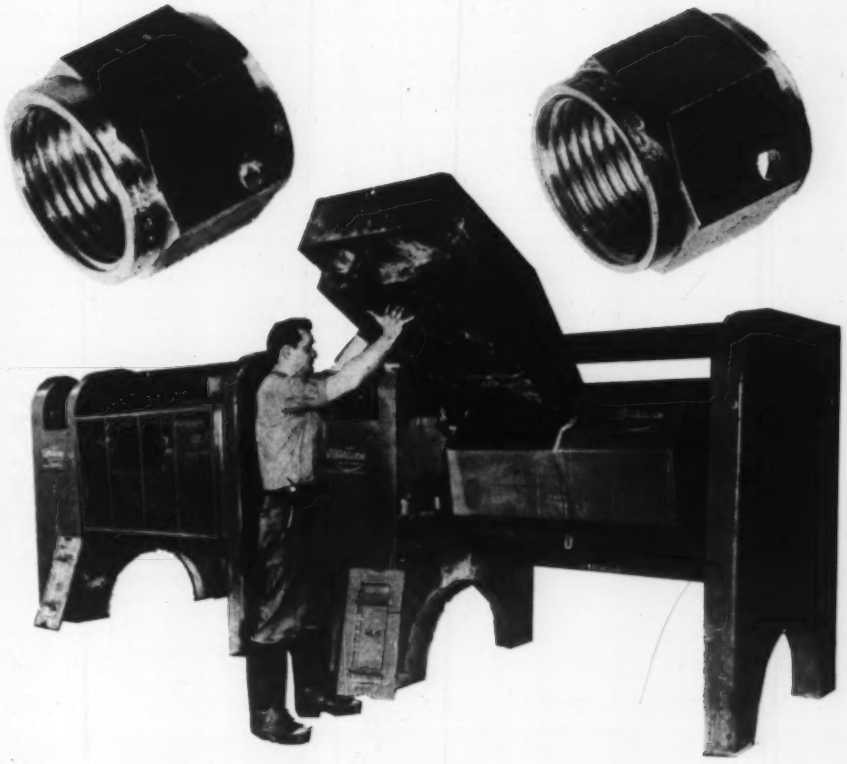
Digital information is received from a punched-paper-tape reader and on-off switches and relays, and is transmitted by means of an automatic typewriter, tape, and on-off relays. The computer also functions as an advanced data logger, printing a record of variables monitored, calculation results, and control actions.

The programs of instructions which direct the computing and control actions are loaded into the magnetic-drum memory. The capacity is 7936 words of general storage (62 tracks of 128 words each), 16 words of fast-access storage, and 128 words in one track containing a nonerasable loading program. Each instruction occupies two words of storage. Safety features prevent accidental erasure. The computer can perform 1000 additions or 350 multiplications per second.

The RW-300 contains approximately 175 $4 \times 4^{1}/_{2}$-in. insert boards of 37 different types, with circuit components mounted on one side of these epoxy-glass laminates. The components are connected by flush-etched wiring and dip soldering on the other side of the boards. Circuit boards are plugged into modules. Each module is limited to a particular function, making it easy to trace possible trouble. Modules are in turn plugged into subframes.

For ease of servicing, complete test equipment is built into the RW-300. This includes an oscilloscope, neon indicating lights, and two voltmeters. The test and maintenance unit permits rapid, thorough checking of the circuitry and programs of instructions. One of the tests provided is marginal checking, which causes weak components to fail under test instead of during normal operation.

The digital control computer is desk size—56 in. wide, 29 in. deep, 36 in. high. Weighing only 400 lb, it uses only 500 watts of 115-volt 60-cycle power.



Inside diameters and difficult problems like the burred edge around the small hole can be barrel finished with Vibraslide equipment. Parts or abrasive are loaded into the Vibraslide machine by a hopper handled with a small overhead crane. Mechanical screening separates parts from the abrasive when the finishing is completed.

Vibrating Barrel Finishing

By LITERALLY shaking up an old process, barrel finishing has been speeded up 70 per cent and can be used to finish inside diameters for the first time.

The "Vibraslide" system, manufactured by the B. W. Elliott Manufacturing Company, Inc., Binghamton, N. Y., combines the principles of rotation and vibration to produce extremely rapid results and is capable of utilizing either principle alone to achieve unique as well as standard results.

Barrel finishing is used for chipping, grinding, or peening actions to deburr, descale, burnish, or polish metal stampings or castings. This is done without resort to hand finishing, or can be used to reduce hand burring and filing to a minimum.

Many parts that were previously not adaptable to ordinary barrel finishing because of material or design can be done in the vibrating barrel. The machine was demonstrated by the Minnesota Mining and Manufacturing Company, St. Paul, Minn., the exclusive distributors, at the plant of one of their local distributors, Metal Finish, Inc., Newark, N. J.

The machine resembles a standard octagonal barrel, except that the frame is necessarily larger—67 1/2 in. × 50 in. × 8 ft—to accommodate the vibratory system. The entire "power pack"—that is, the two motors and the vibrating mechanism—can be slipped out from the back of the barrel frame for maintenance without dismantling the barrel. Other barrel components are standard.

The vibratory barrel will operate at rotating speeds from 4 to 20 rpm. The speed of the vibrator is fixed at 2300 cpm, and both ends of the barrel are synchronized with timing belts so that vibration is uniform throughout the media.

The rapid rate of stock removal, even with the barrel rotating at 4 rpm, makes it possible to process delicate or large parts which previously had to be fixtured to prevent breaking or other damage. Size is of consequence only in separating the parts from the abrasive.

A scrubbing rather than a tumbling action is desirable in barrel finishing, and the key to the speedier operation of the Vibraslide system is the fact that vibration livens up the flow pattern of the silicon sand, carbide, aluminum oxide, or other abrasive material, taking away the dead area at the bottom. Vibration also induces the abrasive material to flow into the interior of complicated parts. The action is so gentle that glass stemware, inserted in the machine as a demonstration, does not break.

Minnesota Mining is also the manufacturer of Ceramicones, made of high-strength ceramic molded under high pressure to exacting tolerances. These may be used to finish parts ranging from the hardest steels down to fragile die castings and molded plastics. Their truncated-cone shape makes every part a working surface. The apex is especially designed to enter and deburr small holes, while the broad base prevents lodging. They are nonporous, prevent contamination by finely divided particles, and their noncrystalline structure resists fracture.

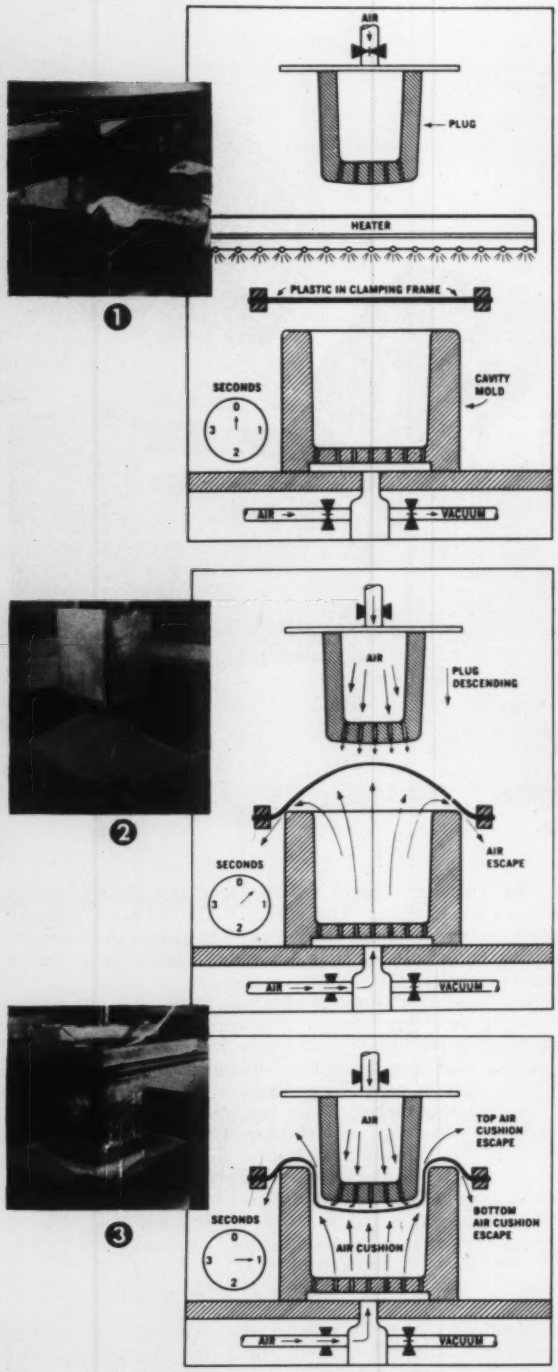


Figure 1. Plastic held in clamping frame in position over cavity mold, is heated to proper molding temperature. Heating time varies according to type and thickness of material. *TIME (at end of heating cycle) 0.0 seconds.*

Figure 2. (TIME 0.5 seconds) Clamping frame is draped to elevation slightly below top of cavity mold. Air is introduced into cavity mold and pressure build-up causes plastic to stretch into bubble. Excess air escapes over lip of cavity mold.

Figure 3. (Time 1.0 seconds) Hot plug descends into plastic bubble. Air escaping from bleed holes in the plug form second Air Cushion, allowing hot plastic to continue to stretch to general shape of final piece, yet maintain highly uniform wall thickness.

Figure 4. (TIME 1.5 seconds) Hot plug at full descent. Hot plastic has general configuration of final shape, but has not yet been molded since it is supported between hot plug and cool cavity mold by *cushions* of moving air. Continuous introduction of air and allowing air to escape automatically adjusts air cushion pressures to prevent pocket build-ups, etc.

Figure 5. (TIME 2.5 seconds) Vacuum is drawn as air introduction is stopped, and hot plastic immediately snaps to conformity with cavity mold. Simultaneously the hot plug starts withdrawal. Plastic is now deep-drawn with high degree of uniformity in wall thickness. Plastic chills rapidly in cold mold, and may be removed quickly by assisting drape-lift action and air jets. Air continues to flush mold of residual heat to insure fast repeat cycles.

Deep-Draw Vacuum Forming

A NEW technique in vacuum forming called "air cushion control" has removed obstacles to the difficult problem of extremely deep-draw forming on a high production basis. With this new method it is possible to deep-draw form heavy gage polyethylene of all types, with high uniformity of wall thickness and relatively low corner radii. The method is equally successful for thin or heavy gage Kralastic, heavy sections of high-impact styrene, vinyl, and other commonly used thermoplastics.

The key to the process, developed by the Auto-Vac Company of Bridgeport, Conn., is a method by which the heat-softened plastic is caused to stretch uniformly while seeking configuration to the shape of the mold.

This is accomplished in an extremely short time in the fast-forming cycle and amounts to a sort of preforming before actual vacuum forming takes place. A cavity-type mold and a heated assisting plug are used in combination with an ingenious utilization of air pressures. These form cushions of moving air, on both sides of the hot thermoplastic, which prevent chilling contact of the plastic and the molds in the extremely short time when the plastic must preform to the general shape of the molded piece. At the same time, they stretch out in a manner to maintain high uniformity of wall thickness.

Electric Power

NEW PEAKS were established in the areas of electric energy produced and electrical generating capacity installed during 1957, according to a summary published in *Combustion*.

Specifically, the new totals are: The highest 12-month (October, 1956–September, 1957) electric energy production ever established by the public utilities—nearly 627 billion kwhr—better than 5.9 per cent above the roughly 592 billion kwhr figures for the same October to September in 1956. However, the month of September, 1957, produced 7.0 per cent less kwhr (51.6 billion) than did August, 1957 (55.45 billion). Combined utility and industrial-energy production reached 5.5 per cent above that of the same 12-month span in 1956 to about 712 billion kwhr. Utility and industrial generating capacity aggregated 143,034,774 kw on September 30, 1957.

All the foregoing are based on the latest available Federal Power Commission reports. This same source further puts installed capacity of utility generating plants at 126,240,051 kw on September 30, 1957, as against 118,660,912 kw reported in service on September 30, 1956. Industrial generating capacity, according to the FPC, rose slightly from the 16,446,126-kw level as of September 30, 1957. This industrial capacity includes the stationary plants of electric railroads and railways.

Capacity Additions

Manufacture of heavy electric-power equipment continues at a high rate according to the Twenty-Second Semi-Annual Electric Power Survey of the Edison Electric Institute, the *Combustion* article continues. Scheduled production for shipment in 1958 stands at an all-time record of 17.8 million kw, 90 per cent of which is for U. S. electric-power systems. The total capacity of new generating units placed in commercial operation since the beginning of 1957 will add up to about 5.5 million kw.

Capability of the electric-power systems is estimated to reach over 131 million kw by the end of 1957, an increase of almost 7.9 per cent for the year. The scheduled capability at the end of 1960 will exceed 171 million kw, an annual average increase of 8.2 per cent from the end of 1955.

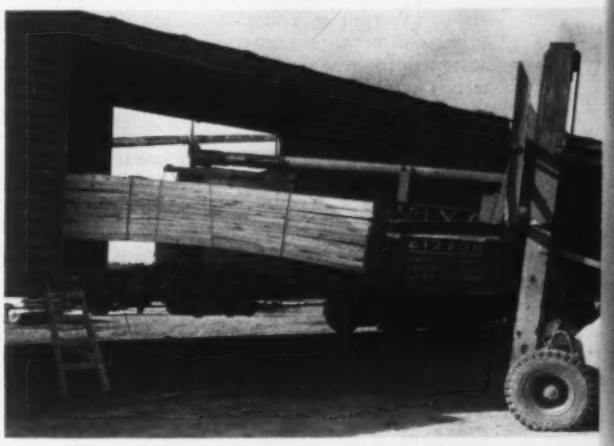
Peak load for the country as a whole still occurs in December, and it is believed that the final return for December, 1960, will be about 112 million kw. The December, 1960, peak EEI estimates at about 141 million kw. This will represent an average annual increase from 1955 of 7.6 per cent.

The EEI feel their latest survey indicates electric power requirements throughout the United States will continue to show substantial increases during the next few years.

Thermal power projects in the EEI compilation on order and scheduled for shipment as of October 1, constitute 91 per cent of the scheduled generating capacity expansion and the remaining 9 per cent is hydro. The size of thermal generating units continues to increase. The largest unit now on order is rated at 500,000 kw.

Gas Turbines

Gas-turbine generating capacity expected to be delivered in 1957 and 1958 throughout the world is estimated to be about 780,000 kw, while the total delivered during the past 11 years up to and including 1956 was 566,000 kw. These figures do not reflect the even more rapid growth in the use of these gas turbines for mechanical-drive and process applications.



With a Fowler Loader, a lift truck can reach right into a boxcar. No loading docks are needed and the loader can work from any level to any other level.

Boom Loading

THE Fowler Loader, a boom-type attachment for lift trucks, is distributed by the Signodé Steel Strapping Company of Chicago, Ill. The boom is adjustable in length from 14 to 17 ft, extends horizontally in front of the forks, and swivels so that it can swing 3 to 4 ft either side of center. At the outer end of the boom is a 360-deg swiveling plate for the attachment of two $^3/_8$-in-diam steel cables upon which the load is slung. Provision is made for quick attachment and adjustment of these slings. The complete loader weighs about 1500 lb.

The loader is attached to a lift truck simply by driving up to the loader, which is "parked" with the boom horizontal (supported near the outer end on a sawhorse or stand), and slipping its forks into the channels provided in the loader base. A hook is used or bolts are tightened to brace the boom to the mast depending on the type of truck. Then it's ready to go.

There are no hydraulic or electric motors or controls.

To raise the load, the operator simply raises the forks.

The weight capacity of the loader will ordinarily depend upon the truck to which it is attached. It has successfully handled loads over 4400 lb when attached to a 15,000-lb-capacity lift truck, but weights should probably be limited to two tons, and less, when smaller trucks are used. It can handle loads over 25 ft long.

The greatest use will be in loading and unloading bulky, long loads (like lumber packages) into and out of boxcars. The boom can spot a lumber package at any point inside the usual staggered-door boxcar, while the truck remains on the ground outside the car. No ramps or other special loading facilities are needed.

Metal-Powder Rolling

METAL POWDERS are compacted directly into sheet and strip in a horizontal rolling mill developed by Stanat Manufacturing Company, of Westbury, N. Y., also convertible to a vertical 2-high/4-high mill.

For the metal-powder-rolling operation, the mill was designed to produce both ferrous and nonferrous materials in widths up to 7 in. and thicknesses ranging from $^1/_{32}$ to $^1/_8$ in., depending on the particular metal powder being processed.

The mill should be useful to research, development, and pilot-production activities concerned with the fabrication of such critical items as nuclear fuel elements, aircraft filtration systems, and new alloys for rockets and ballistic missiles.

Unusual flexibility of design permits the substitution of both wider and larger-diameter rolls. For example, 10-in-diam × 12-in-face-width rolls can be used instead of the 8 × 8-in. rolls with which the mill has initially been equipped. Capacities can thus be increased to produce sheet widths up to 11 in. and thicknesses in excess of $^1/_8$ in. with certain metal powders.

The new mill, which weighs approximately 25,000 lb and is designated Model TAH-625, can be used for both hot and cold-rolling operations. High-temperature-resistant rolls equipped with electric-cartridge heater elements can be supplied.

The compacting-by-rolling technique is quite simple in principle. The metal powder is merely fed between revolving rolls and a solid, uniform mass produced. Several variables such as roll diameter, roll gap, and roll speed determine strip qualities. Different methods of introducing material to the rolls may be employed by various hoppering techniques aided by vibrators for uniform feed rate.

Laminations may be produced by directing streams of dissimilar powder into the roll gap. Powder may also be compacted between strips of wrought metal to form a "sandwich" as is sometimes done in the manufacture of certain types of nuclear fuel elements. Impregnation of cloth with powder has been successfully carried out.

For powder-rolling operations, the rolls are arranged in a horizontal plane and a chute is provided to carry the resultant strip from the rolls. The width of the strip is controlled by side platens which are adjustable over the width of the rolls, enabling the formation of strip from $^3/_4$ in. and wider, up to almost the face width of the compacting rolls.

Metal powder, here being hand fed into the rolling mill, emerges as strip metal from the chute at *lower left*

Practically all metal powders compacted into strip must be sintered within a protective atmosphere such as hydrogen or argon to increase their strength and ductility. The process is usually completed by rerolling the sintered strip in either a 2-high or 4-high rolling mill.

Roll frames are constructed of high-tensile cast steel with each housing post having a cross-sectional area of 56 sq in. Radial loads are taken by heavy-duty needle roller bearings, and end thrust is controlled by ball bearings. The roll bearings have a maximum roll-separating force of 350,000 lb at a rolling speed of 25 fpm, and 2500-hr bearing life.

Simulated Free-Piston Engines

GENERAL MOTORS Research Staff can build and test complete free-piston-engine systems mathematically on its Technical Center digital computer.

From prototypes actually developed for automotive and maritime use, mathematical equations were evolved for producing simulated free-piston-engine designs and running them mathematically through a complete series of simulated tests.

These computer-produced engines give engineers such an accurate analysis of what actual engines will do in service that countless conventional cut-and-try experiments with prototypes are no longer necessary.

It was pointed out that the mathematical problems can be worked out in terms of practical variables so that engineers need not use "fictitious numbers" but can utilize the same indications they now get from various gages and instruments conventionally used in dynamometer test cells.

The computer actually draws power, stroke, load

and other curves which are similar to actual test-cell results.

Donald R. Olson, assistant professor, Mechanical Engineering at Yale University, GM research consultant, and Mem. ASME, indicated in a report to the recent Annual Meeting of the Society of Automotive Engineers, that the computer has added a "new dimension" to engineering analyses by enabling engineers to solve analyses that were unsolvable before with conventional mathematical techniques.

Professor Olson said this was believed to be the first instance of the complete mathematical simulation of the free-piston engine with the use of a computer.

Torque Values of Spring Wire

THE National Bureau of Standards, in work sponsored by the Army Ordnance Corps, Springfield Armory, has been investigating the effect of metallurgical variables on the properties of spring wire. Because the wire from which helical extension or compression springs is wound is stressed in torsion, a means was sought for measuring the torsional properties easily and accurately. Consequently, an apparatus was constructed that automatically records the torque-twist characteristics of wire less than 0.05 in. in diameter.

Designed by H. C. Burnett and J. A. Bennett of the mechanical metallurgy laboratory, the equipment provides a rapid, easy method for determining the torsional properties of small-diameter wire. The spark recording system utilized is entirely frictionless so that even small torque values can be recorded accurately. The apparatus should be of general utility in developing more significant specifications for the spring wire used in many types of ordnance items.

The method of making the measurement is to couple the test wire in series with a larger-diameter calibrated wire and to rotate one end of the assembly. The twist in the calibrated wire is a measure of the torque and is recorded on one axis of a chart, while the twist in the test wire is recorded along the other axis.

NBS machine records torsional properties of small-diameter wire. A damping cup is being placed around the measuring wire. Recording is accomplished by a spark jumping from the helical electrode on the outside of the paper cylinder to the movable-bar electrode inside.

The framework of the device is a table with two shelves clamped to the legs. A small motor and reduction gear are mounted on the table surface. The wire undergoing test, cut to a length of approximately $6\frac{1}{2}$ in., is suspended from a coupling attached to the motor's shaft which extends through an opening in the table surface.

The bottom end of the test wire is coupled, through an opening in the middle shelf, with the measuring wire which is of larger diameter and about three times as long as the test wire. The measuring wire is held in a coupling keyed to the bottom shelf and is spring loaded to provide a small amount of tension to both wires. To eliminate oscillations, an inverted damping cup, immersed in a pan of light oil, is fastened to the coupling at the bottom of the test wires.

A fixed helical electrode is mounted on the middle shelf. Fitted vertically inside the fixed electrode is a movable-bar electrode supported by the coupling between the two wires. A cylinder of heat-sensitive paper, on which the torque-twist measurements are recorded, is taped firmly around a disk attached to the top of the test wire. This paper cylinder, scaled at appropriate torque and twist values, hangs suspended between the movable-bar electrode and the fixed helical electrodes without touching either one. Both of the electrodes are designed with a knife edge so that the position of the spark locates accurately the point where the electrodes are closest together.

To conduct a test, the upper end of the test wire is rotated by the motor and reduction gear at an angular speed of about 100 deg per min. At the same time, an interrupter and ignition coil produce sparks at 5-sec intervals between the two electrodes, causing a line of small black dots to appear on the paper.

The angular deflection of the movable-bar electrode is proportional to the torque applied to the measuring wire. This deflection displaces the position of the spark vertically on the paper. The position of the spark is displaced horizontally by the twist in the test wire. It is this twist in the test wire that causes rotation of the paper cylinder relative to the movable-bar electrode. Thus as the sparks pass through the paper from the fixed to the movable electrode, the torque-twist relationship of the test wire is recorded.

The machine fills a gap in the equipment now available for testing small-diameter wire. Its construction allows flexibility in the length of test wire and the torque range of the measuring wire. The device also has the advantages of low first cost and an absence of complicated accessories.

For further technical details, see Burnett, H. C., "A Recording Torsion Testing Machine for Wire," ASTM *Bulletin*, in press. Readers may also be interested in Gardiner, F. J., and Carlson, Harold C. R., "The Spring Back of Coil Springs," ASME Paper No. 57—A-75, on the method of calculating the exact arbor diameter required to produce a specified outside diameter of spring for any material. The paper is available in pamphlet form from the ASME Order Department, 29 West 39th St., New York 18, N. Y., and will be published in MECHANICAL ENGINEERING.

Synthetic-Rubber Pilot Plant

SYNTHETIC RUBBER with the molecular structure and performance characteristics of the natural tree-grown product, has moved from small-batch laboratory scale to a tonnage basis with completion of a large new pilot plant by The Goodyear Tire and Rubber Company at Akron, Ohio.

Goodyear's highly instrumented pilot plant, built at a cost of approximately $\$^3/_4$ million and designed exclusively for the production of Natsyn, as the natural synthetic rubber is called, has a tonnage capacity which will enable extensive production-scale tire building and evaluation trials. These are in anticipation of the world-wide shortage of natural rubber forecast for 1960 and thereafter. They will also provide a buffer against runaway natural rubber prices such as have occurred in the past.

Goodyear expects soon to undertake the engineering of a full-scale Natsyn production plant with 25,000 to 30,000 tons annual capacity.

Full commercial-scale production of Natsyn depends upon the availability of isoprene, a petroleum derivative. At present, the supply of isoprene is inadequate, with only one commercial producer in the United States, but development processes for making a low-cost, high-purity product appear to be well under way.

Natsyn is made from the same basic molecule of isoprene that is found in the rubber tree, but where the rubber tree requires about seven years from planting before it produces rubber latex, Natsyn can be polymerized in a matter of hours.

Highly purified isoprene and solvents are pumped from storage tanks outside the pilot plant into an additional purification system within the plant. Following this step, these ingredients are carefully measured in proper proportions in weigh tanks and then charged into reactors with a catalyst.

After polymerization has taken place, the Natsyn is drawn from the reactor in the form of a thick viscous material. Then, through a unique drying process, unreacted isoprene and solvents are removed, leaving the "synthetic natural rubber" in crumb form, ready for baling.

From this point, Natsyn is handled, compounded, processed, and built into tires in exactly the same manner as natural tree-grown rubber, and with all the inherent properties and characteristics of natural rubber.

Blood Heat Exchanger

A BLOOD heat exchanger marks a new advance in safeguards for patients who undergo complex open heart surgery. By means of an automotive-like transmission-oil-cooler device now in use at the Duke University Medical Center, Durham, N. C., a patient's body temperature can be reduced ten degrees in as little as five minutes.

Wirt W. Smith, of the Duke surgery staff, reported on the device at a recent Conference on Methodology and Problems in Artificial Internal Organs held at the Rockefeller Institute in New York, N. Y.

Formerly, patients were cooled with ice packs or refrigerated blankets. This process took an hour or longer and was hard to control in terms of desired temperatures. Surgeons using the heat exchanger can lower a patient's temperature at an average rate of 1 deg F every 30 sec, raise it with almost equal speed, and control it with an accuracy of $^1/_2$ deg.

Examining the weld to the header of the 24 tubes through which the blood flows in the 10-lb blood heat exchanger used in heart surgery

The heat exchanger was developed co-operatively by Duke medical scientists and research engineers at the Harrison Radiator Division of General Motors Corporation, with plants in Lockport and Buffalo, N. Y. It was especially designed to take into consideration the complex physical characteristics of human blood and to meet other safety requirements for use in surgery, the Duke doctor pointed out.

Dr. Smith reported on behalf of the medical-industrial research team headed by Ivan W. Brown, Jr., associate professor of surgery at Duke, and Willard O. Emmons, engineer of the Harrison Radiator Division, which donated facilities and the services of research personnel. Development of the heat exchanger required some 10 months of planning and experimentation.

Edward D. Rollert, Harrison's general manager, stated that the Division would continue to make available its research facilities to Duke University for the further development of the blood heat exchanger.

The heat exchanger is being used at Duke in heart operations that involve an "artificial heart-lung" machine combined with hypothermia, or lowering the patient's body temperature. The heart-lung machine takes over the work of a patient's own heart and lungs. Then, surgeons can open the heart and repair congenital defects such as holes or obstructions.

Lowering the patient's temperature greatly reduces his oxygen needs and thus permits lower flow rates through the heart-lung, protecting the brain and other vital organs. Hypothermia also lessens damage to blood cells and reduces the chances of certain complications.

Epoxy-Alloy inserts of tools used in producing a bottom panel for a refrigerator produce a cavity in the stamping that provides the proper clearance for the refrigerator compressor

After producing 130,000 units for 0.025-in-thick brass, the full year's requirement for one auto model, parts were still passing quality inspections at the Borg-Warner Corporation

Basically, the heat exchanger consists of a group of slender stainless-steel tubes enclosed by a specially constructed steel jacket. As blood flows through the tubes, water is circulated about them. The temperature of the circulating water is automatically regulated and can be precisely controlled to either cool or warm the flowing blood. It weighs approximately 11 lb.

The heat exchanger is connected by plastic tubing between the heart-lung machine and the patient's body. Blood is pumped from the patient through the heart-lung where it picks up a new supply of oxygen, and then back to the patient by way of the heat exchanger where its temperature is either lowered or raised.

Dr. Smith pointed out that the heat exchanger can be used with any type of heart-lung machine as well as with other devices such as artificial kidneys.

Reinforced Plastic Tooling

A PLASTIC-TOOLING method, based upon an epoxy-resin system reinforced with metal or glass fibers and metal-fiber flocking, permits runs up to 150,000 stampings where low-gage softer metals are to be formed. Also, this technique is applicable to prototype and development-type metal-forming dies, secondary-operation dies, hydroform and rubber-pad forming dies, stretch dies and fixtures.

This material and process innovation known as Epoxy-Alloy was developed by the Bakelite Company, a Division of Union Carbide Corporation, who supply raw materials but not the composition itself.

Reduced tooling time and cost economies, commonly associated with plastic tooling, are inherent in this new technique. Additional significant improvements over conventional plastic tooling include mass casting of the tools and dies, substantially increased thermal conductivity, and greater modulus and impact strength. The entire tool is pressure cast and is also cured simultaneously.

To date, approximately 70 Epoxy-Alloy dies have been put into commercial operation. Over 130,000 stampings of a 0.025-in thick brass automotive radiator covers have been made from one such die. Another has formed more than 65,000 units from 0.035-in-thick steel for a refrigerator section. This die was delivered in five weeks, half the time required for metal dies. Thirty-five Epoxy-Alloy dies for a military project were built in 15 weeks at a cost of $250,000. Conventional metal tools, it is reliably estimated, would have required up to 18 months of tooling time at an approximate cost of $2 million.

An extensive three-year research and development program, carried out by Bakelite Company in co-operation with tool and die fabricators, preceded the announcement of the process. These investigations have shown that draw dies of Epoxy-Alloy can be used for: (*a*) Runs of 50,000 to 150,000 or more stampings of the thinner more easily formed metals; (*b*) runs of 10,000 to 50,000 stampings in which Epoxy-Alloy contoured punches and pads are used with metal inserts, draw rings, and blank holders; (*c*) runs of 1000 to 10,000 stampings without the use of metal rings or inserts; and (*d*) prototype or development runs encountering deep draws of heavy metal or large compound-contour stampings of up to $^1/_4$-in-thick steel.

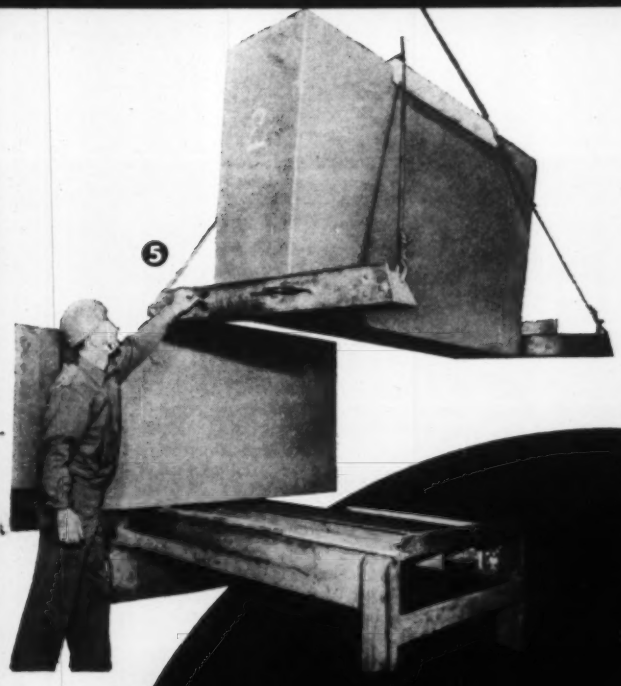
PHOTO BRIEFS

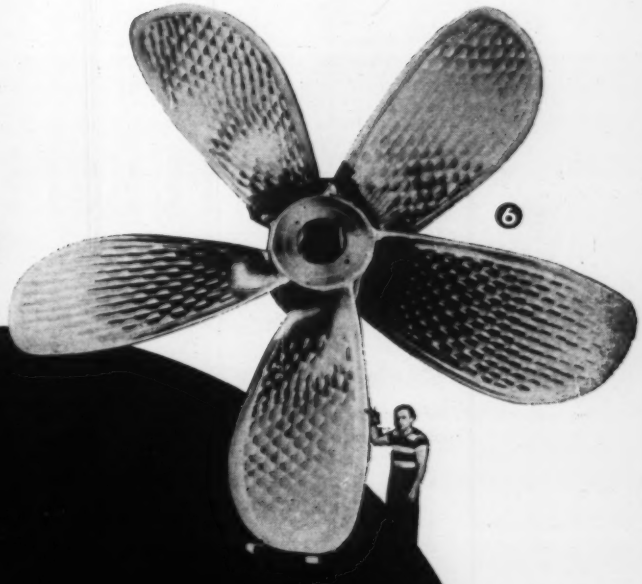
1 Plastic Pipeline. Sections of the 6200-ft polyethylene pipe which transports saturated brine solution from the zirconium and titanium-sponge plant of Mallory-Sharon Metals Corporation to the reservoirs in the electrolysis plant of U. S. Industrial Chemicals Company at Ashtabula, Ohio, are coupled with welded and bolted flanges. The 30-ft sections of the 1-in-thick 6.07-in-ID pipe weigh only 120 lb each. The pipe is highly impervious to corrosion from the 80 to 90 F, 75-psig solution and is assembled by simply rolling into place.

2 Commercial Jet. A model of the swept-wing Convair 880, the world's fastest commercial jet transport, is prepared for wind-tunnel tests at the San Diego, Calif., plant. The 88-passenger (109 coach), 615-mph-cruising-speed luxury liner, equipped with four General Electric CJ-805-3 jet engines, made its first flight in January. Delivery starts in November to several American airlines.

3 Stretchable Paper. A 10-lb billiard ball dropped on Clupak stretchable paper, commercially produced by West Virginia Pulp and Paper Company, bounces without rupturing the sheet, while the other ball drops through ordinary paper. Possible applications include paper-metallic laminates, shotgun shells, and wrapping impregnated with rust inhibitor to protect machined engine parts against corrosion.

4 Auto "Handling." Response of a full-size vehicle to various steering-gear "inputs" can be predicted by General Motors engineers from the electric analog computer linked with a miniature automobile on the simulator. Similar in principle to aircraft flight-simulation techniques, the device permits calculation of lateral response to steering changes. Any combination of wheelbase, weight distribution, suspension, and other car and tire characteristics may be introduced, for speeds of 30 to 100 mph.





5 Graphite Reference Forms. Graphite slabs 20 X 46½ X 84 in. will be accurately machined into intricate shapes. Stainless-steel components will be placed on them for furnace brazing together at high temperatures to form honeycomb panels. Convair ordered the 2½-ton blocks of high-grade graphite from the National Carbon Company division of Union Carbide when graphite was found to be the only acceptable material because of dimensional stability at elevated temperatures and resistance to thermal shock.

6 Nialite Propeller. High resistance to seawater corrosion of Nialite, a zinc-free nickel-aluminum bronze with high-strength lightweight properties, led California Transport Company to install this 21-ft propeller on a tanker. After three years of service the propeller showed no signs of wear due to erosion or cavitation. The pattern of polishing marks in the photograph, taken when the propeller was made by Baldwin-Lima-Hamilton, is now gone and there are some stains. Estimates indicate that the Nialite propeller could save more than twice its $50,000 cost in six years.

7 Ingot Pot Car. Designed to carry 37 X 72 X 90-in. ingots weighing up to 57,000 lb, this 100-ton ingot pot car manufactured by the Blaw-Knox Company operates on the 44-in. slabbing line at the Edgar Thompson Works of United States Steel. The car delivers 30 ingots per hr from 20 different soaking pits. Two 75-hp mill-type traction-drive electric motors mounted on the car operate it at 562 fpm.

8 Largest Titanium Plate. A 75 X 224-in. plate of Ti-75A titanium alloy with 3 16 in. nominal thickness, the largest light-gage plate of titanium ever produced, was made by Titanium Metals Corporation of America for use in a reactor vessel for chemical processing. The average size of work of this kind is only 36 X 72 in., and 48 X 120 in. was the previous record.

Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

Britain's Television Tower

THE British Broadcasting Corporation has now brought into service a new television transmitting tower; 708 ft high, it is the tallest unstayed structure in the British Isles and stands on Sydenham Hill, seven miles south of London Bridge, on the site of the former Crystal Palace.

The base of the tower is 120 ft square, from which it rises in twelve panels of diminishing size to a height of 429 ft, where it is 14 ft 6 in. square. At this height there is a platform from which rises the steelwork supporting the aerials.

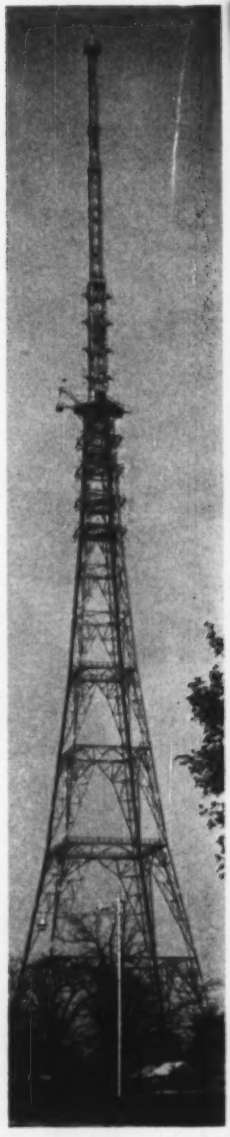
The tower is built on a foundation of 40-ft piles, some vertical and some raking, capped with reinforced-concrete blocks in which grillages were cast to hold the foundation bolts. The corner members consist of four 7-in. equal angles, placed back to back in cruciform arrangement. These extend up to the platform at 429 ft, above which the corner members are solid round bars with welded flanges; the largest bars are 8 in. in diam.

The total weight of steel in the tower is 450 long tons. Some parts of the upper structure weighed more than 3 tons each, and these had to be lifted and placed in position some 500 ft above ground.

Two masts, one 230 ft and the other 125 ft high, were used for the initial stages of erection, and as the structure rose the smaller mast was converted into a floating derrick; wire ropes support the corner members of the tower. The topmost aerial pole was raised into position between two summit derricks, mounted on the sides of the structure about 670 ft up.

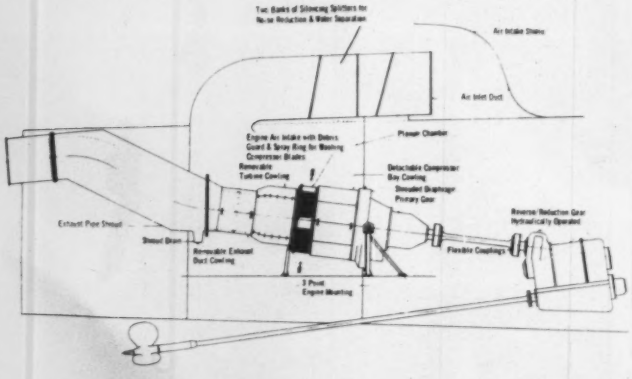
For access to the aerials there is a two-man electric hoist which travels to a landing about 400 ft above ground; above that point, the maintenance men must climb ladders. The hoist can be controlled from the cage and from the upper and lower landings, and there is telephone communication between the three control positions. The hoist travels up the slope of one of the corner legs, but remains vertical, irrespective of the slope of the legs.

When the tower was completed, it was tested for resistance to wind pressure by firing groups of rockets, attached to the structure near the top and designed to give a total horizontal thrust more than equal to the greatest wind force likely to be imposed on it.



Television transmission tower, 708 ft high, is the tallest unstayed structure in the British Isles. Tower's resistance to wind pressure was tested by firing 12-ton thrust rockets attached 48 ft below top platform.

Installation of British Proteus gas turbine in new type of motor gunboat for the British Navy. Use of the aircraft-type gas turbine will increase total power of the craft an estimated 35 per cent.



New Fast Patrol Boats

PACKING more and more horsepower into less and less space has been a problem ingeniously solved in the case of a new class of medium-fast patrol boats for the British Navy, the first of which, the *Brave Borderer*, was launched in January at Portsmouth, England. The over-all length of these new boats is 98 ft 10 in. and the length between perpendiculars 90 ft. The beam is 25 ft $5\frac{1}{2}$ in. and the depth 6 ft. The boats have three screws, driven by Bristol Proteus gas turbines (the type used in the Britannia aircraft) which have been adapted for naval use by Bristol Aero Engines, Ltd., Filton, Bristol, England, in conjunction with W. H. Allen, Sons & Company, Ltd., of Bedford, England, who have supplied the primary reduction gears and the reverse reduction gearboxes. The vessels have three propellers and the engines are placed over the propeller shafts, the output shafts

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leading forward through the primary reduction gears to the reverse gearboxes, which they drive through skew gears with an angle of about 13 deg between their input and output shafts. The gas turbines run on ordinary diesel fuel and have a maximum rating of 3500 hp each and a maximum continuous rating of 2800 hp. The striking feature of the Proteus engine is that, including the weight of the primary reduction gear, it will give 1 hp for every 0.83-lb weight of the installation; or, including also the reverse reduction gearbox, 1 hp for 1.6-lb weight. The vessels carry no diesel auxiliaries, electrical power being provided for this purpose by Rover gas turbines, using the same fuel as the main engines and driving 40-kw generators, supplied by the Metropolitan-Vickers Electrical Company, Ltd. The craft are designed to function either as motor gunboats or as torpedo boats. Equipped for the former duty they will carry one 3.3-in. gun in a turret, fitted with a stabilization system capable of counteracting the severe motion to be expected in a vessel of this type, together with one 40-mm single-barreled Bofors gun and two 21-in. torpedoes. If fitted out as torpedo boats, they will carry four 21-in. torpedoes and one 40-mm Bofors gun. The complement will be three officers and 17 ratings, with the addition of two more ratings in the senior officer's ship of a squadron. The hull is of composite wood and metal construction, and of "hard chine" form. It is reckoned that the use of the aircraft-type gas turbines will give an increase of 35 per cent in total power, combined with a reduction of 50 per cent in machinery weight and 25 per cent in machinery space, compared with the type of machinery hitherto employed for craft of this kind, which are intended primarily for offensive operations against enemy warships and merchant ships in coastal waters.

Inspection Unit for Railway Viaducts

INSPECTING the underside of the arches of high railway bridges, especially those which cross rivers, can present some difficult problems. A solution to them has been found by the Civil Engineering Department of the North Eastern Region of British Railways in the hydraulically operated and rail-mounted inspection unit illustrated, designed, and constructed by the Department in collaboration with two English engineering firms, Simon Engineering (Midlands) Ltd., of Dudley, Worcestershire, and the Auto-Mower Engineering Co., of Nerton St. Philip, Somerset.

The bogie bolster truck on which the unit is mounted is 52 ft long and 7 ft 9 in. wide, and the height from rail level to the truck platform is 3 ft $10^1/_2$ in. On it is an A-frame and slewing gantry, rotatable to either side, and from the gantry end depends the upper boom, 21 ft long. The lower boom, 17 ft long, is hinged to the lower end of the upper boom and has at its own lower end the examiners' inspection platform, 7 ft long and 2 ft 10 in. wide, which can carry a load of 600 lb. A parallelogram system of leveling rods keeps the platform horizontal, irrespective of the angles of the two booms. It is possible to carry out inspections to a depth of 29 ft below rail level and to insert the platform under an arch to a distance of 15 ft from the outside face.

Two 300-w floodlights are mounted on the platform and can be swiveled in any direction; and electricity for these and for portable tools is available from a 3-kw d-c generator on the truck, driven by a Petter diesel engine.

A hydraulically driven winch on the underframe of the truck carries 100 yd of $^3/_4$-in. wire rope, the ends of which are anchored on the track ahead of and in rear of the truck, which can thus be drawn along the bridge. The winch can be operated either from the gantry platform or by remote control from the inspection platform; in the former case the maximum speed of travel along the track is 40 fpm and in the latter 20 fpm.

The slewing gantry is designed to clear a parapet wall 4 ft 6 in. above rail level, with a margin of 7 in. Its motions are actuated by a 5-in. hydraulic ram with a stroke of 36 in. The upper and lower booms are of box section, formed from light-gage steel pressings, with welded bulkheads to give rigidity. A 6-in. ram of 36-in. stroke, mounted on top of the gantry frame, swings this boom from the horizontal to 85 deg below, and a similar ram actuates the lower boom, which can travel from 30 deg above to 60 deg below the horizontal. All movements can be operated from the inspection platform as well as from the gantry. All hydraulic controls are duplicated to insure safety and are fitted with automatic locks to guard against a hydraulic pipe failure. A Petter twin-cylinder four-stroke air-cooled diesel engine drives three hydraulic pumps; one delivers $2^1/_4$ gpm at 1000 psi to the rams operating the slewing motion and the booms, and the other two, delivering 5 gpm at 1200 psi, serve the winch.

Communication between the truck and the inspection platform is by two field telephones. The development of the unit was carried out under the direction of Mr. Arthur Dean, M.Sc., Chief Civil Engineer for the North-Eastern Region of British Railways.

Hydraulically operated rail-mounted unit for inspection of underside of arches of high railway bridges

Substance in Brief of Papers Presented at ASME Meetings

M. ZANFARDINO
Staff Editor

ASME TECHNICAL DIGEST

Fuels

Economics of Heating and Power Systems for Large Industrial Plants .....57—A-123

By W. T. Batcheller, Mem. ASME, Seattle, Wash. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Isolated thermal-electric plants tend to involve higher unit construction and operating costs compared with large central stations except in regions enjoying especially low-cost fuel. It has, however, been found practicable to generate high-pressure and high-temperature steam for purposes of combined generation of process and heating steam and electric power by means of noncondensing and automatic extraction condensing steam turbines. These steam turbines serve as pressure-reducing valves from which the exhaust or intermediate-stage bleeding steam is fed into the steam mains supplying the industrial plants.

Compared with average heat rates for largest and newest central stations such as those supplying the Ohio River valley, which approach 9000 Btu per kwhr of new output after supplying self-consumed power for auxiliaries which include boiler feed pumps, condenser circulating-water pumps, draft fans, exciter generators, and lighting, the comparatively small turbines serving as pressure-reducing valves which remove only around 10 to 15 per cent of the total heat content of the steam, operate at a heat rate of around half that or 4500 Btu per kwhr. The size and cost of steam-generation facilities are not materially increased. The total cost of steam generation is then divided in proportion to respective heat consumptions between heating and process steam and power requirements.

With whatever fuel may be most readily and economically available in each particular vicinity or region, this combined use of steam generated is highly economical. In the present studies, however, the foregoing economies have been greatly enhanced by the addition of another feature or phase in connection with coal-fired thermal generating plants. This feature is particularly effective adjacent to deposits or mines producing high-volatile semi and sub-bituminous and lignite coals, normally classified as low grade but actually richest in by-product-producing volatiles. This feature is the washing, drying, and processing of these coals to remove free ash and to recover, separate, and refine the volatile tars and oils, and convert them into a wide variety of finished products immediately usable by chemical, plastic, paint, and drug industries, and as aviation-gasoline additives, which are salable through existing wholesale distributing channels.

Revenues realized from the sale of these by-products for which the market has been growing at a phenomenal rate are then applied as a credit on the fuel, steam, and power costs, with the result that these costs are controllable by varying the annual tonnage of coal processed in excess of resulting residual char fuel requirements. Fuel costs and steam and electric power costs may be reduced greatly or entirely eliminated by these credits from by-products sales.

The fact that this program makes steam and electric power costs controllable and cheap, appears to make it of greatest general importance to our economy. This paper gives technical, capital cost, and production cost-accounting data along with effects of credit from sale of by-products in varying amounts after providing fuel requirements for any given industry.

Application of Bonus-Penalty Methods to Coals Being Purchased or Evaluated.....57—A-115

By R. M. Schahfer and F. H. Strout, Northern Indiana Public Service Company, Hammond, Ind.; and G. W. Land, Mem. ASME, Truax-Traer Coal Company, Chicago, Ill. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Coal costs are a significant part of the total cost of electricity production, and hence great care must be exercised in the purchase of coal for an electric utility company. The over-all cost of the coal includes the cost of all items connected with converting the heat energy in the coal to steam produced for the turbine.

Four characteristics of coal—moisture, ash, sulfur, and Btu content—which may vary over a wide range, have a definite effect on the usability of the coal, and directly affect the net value to the consumer.

Price per ton or price per million Btu as received, with no adjustments made for the respective quantities of moisture, ash, and sulfur in the coal does not reflect the net value to the consumer. True value to the consumer increases with increased Btu per lb and decreases with increased amounts of moisture, ash, and sulfur present in the coal.

Costs affected by variations in coal quality may be divided into three general classes: Handling charges within the plant; heat losses in the boiler or steam generator; and power replacement costs resulting from decreased boiler availability or capacity.

If adjustments to the cost of coal can be made to reflect properly the increased or decreased costs within the plant resulting from more or less moisture, ash, and sulfur, the true value of the coal may be obtained.

A method has been devised for maintaining the net cost of the coal purchased at the value originally quoted, and for comparing the real or net value of coals submitted for purchase. Applications of adjustments may be made as a bonus for better coal and as a penalty for poorer coal than that guaranteed; hence the name "bonus-penalty method."

In the four years that the bonus-penalty method has been in use, the average Btu per lb of coal received has increased. If a supplier receives an unexpected penalty, he hastens to correct conditions

which cause the delivery of poor quality coal. Conversely, bonuses have encouraged improved coal preparation.

New Concepts in Stoker Design . . . . . 57—A-273

By F. C. Messaros, Mem. ASME, and F. C. Belsak, American Engineering Company, Philadelphia, Pa. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

A new type of stoker has been designed based on the vibration principle. Although combustion performance and the ability to burn a wide range of coals have been major considerations in the development of mechanical burning equipment, the need for greater and greater steaming capacities becomes increasingly important.

This paper relates the development of the first vibrating-type industrial stoker in this country, together with a report of observations and performance obtained from tests on units now in operation both here and abroad.

The basic concept of vibration dictates a body to be freely suspended, and its movement is a function of the relative motion produced between the body and the mechanism causing it to vibrate. The vibrating grate is supported on vertical steel plates which act as flexing members and also form the air compartments under the grate. The grate consists of block-covered cooling tubes which are attached to flexing plates located at fixed points. The grate is inclined at an angle of 14 deg to insure positive fuel-bed travel with the least vibrational amplitude. Many experiments were conducted to determine this optimum angle of incline thereby permitting maximum compacting without avalanching. It is of course realized that the greater the amplitude of vibration, the more adversely affected may be the clinkering tendency.

Suspended from the upper end of the grate is an integrally mounted vibration generator which is driven by an independent motor fitted with a plugging device. A flexible drive arrangement is used to connect the motor to the generator. In effect, the freely supported grate, with its integrally mounted vibration generator, is a self-contained unit free to vibrate in a generally rectilinear direction.

A detailed description of the vibration generator, the furnace configuration and capability, and operation are presented. Vibration and its effect on autocompacting of fuel is described. Performance data on four tests and experience with vibrating-grate installations in Germany are given.

Development and Operating Experience of the Jet-Injection Stoker . . . . . 57—A-192

By N. W. Young, The Babcock & Wilcox Company, New York, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Industry has been searching continually for new and better ways to burn coal. The operating problems involved in small industrial or heating applications are not the same as those for large industrial or central station practice. Stokers are often the only practical solution to the fuel-burning problems for steam capacities up to 200,000 lb per hr.

Currently, three major classes of stokers are in use: Chain and traveling-grate types; spreader or overfeed type; and underfeed type. Of these the chain and traveling-grate types have the greatest number of advantages.

The jet-ignition stoker is another tool which can be used to burn fuel efficiently and produce steam economically.

Fuel is fed in a manner similar to the chain-grate and traveling-grate stokers, that is, from a hopper onto a grate moving rearward under an adjustable coal gate to establish fuel-bed thickness. Combustion air enters a multiplicity of compartments which are controlled individually. Ignition occurs at the front of the stoker over the first compartment, and is maintained by rapid burning of the volatile as it distills from the bed. Quick combustion of this volatile is made possible by the use of high-velocity air jets directed into the distillation zone.

Combustion is completed as the fuel moves with the chain toward the rear of the furnace and ash is discharged continuously at the rear. A detailed description of air and fuel control and chain construction is presented.

Bituminous, sub-bituminous, lignite, Pennsylvania anthracite, and coke breeze are the fuels which can be burned on a jet-ignition stoker. Proper coal sizing is an important factor for any stoker if optimum performance is to be attained. Experience has shown that the sizing should be 1 × 0 in. with 20 to 60 per cent through $^1/_4$ in. Proper size distribution across the width of the grate is important. Proper moisture tempering will improve the performance of the equipment materially with certain fuels.

The performance of any fuel-burning equipment can be judged by knowing the following:

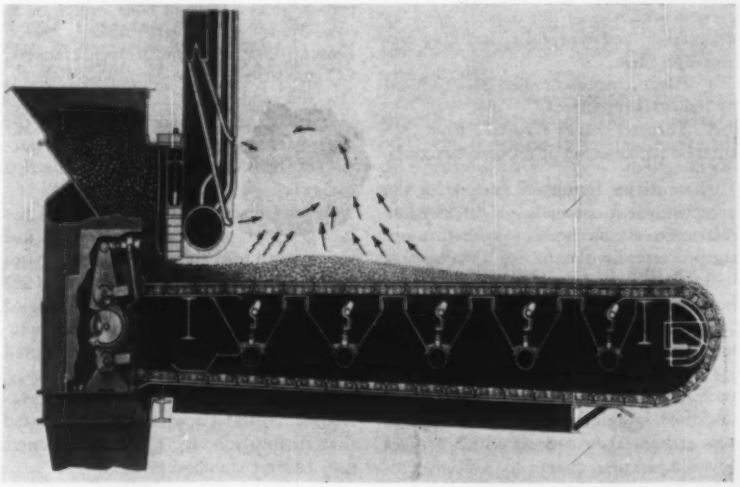
1 The excess air required for smokeless combustion.

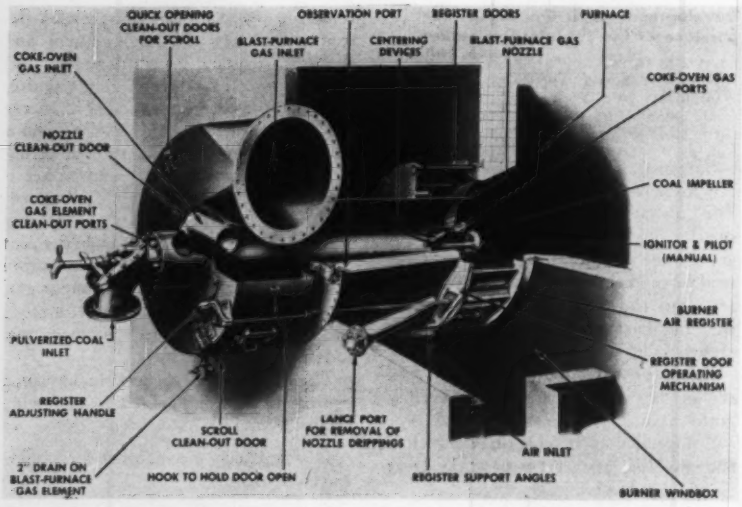
2 The auxiliary power required for movement of combustion air and mechanical parts.

3 The burning efficiency (unburned combustible).

The jet-ignition air pressure required will vary from 10 to 20 in. of water depending upon the amount and condition of the volatile in the fuel. Total power requirements for a jet-ignition-stoker unit are 0.33 hp per 1000 lb of steam, as compared with 1.6 hp per 1000 lb of steam for a pulverized-coal unit, and 0.71 hp per 1000 lb of steam for a spreader-stoker unit. The jet-injection stoker compares favorably with other stokers; however, it has disadvantages as well as advantages, and must be applied with full knowledge of all the conditions which will affect its operation.

Jet-ignition stoker. Ignition occurs at the front of the stoker over the first compartment and is maintained by rapid burning of the volatile as it distills from the bed. (57—A-192)





Circular tri-fuel burner utilizes blast-furnace gas, coke-oven gas, and pulverized coal (57—A-126)

Steam From By-Product Fuels .....57—A-126

By J. B. Walker, Jr., The Babcock & Wilcox Company, New York, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

By-product or "waste" fuels are frequently ignored as sources of fuel for generation of steam. As primary fuels and disposal of industrial wastes become more costly, it is predicted that efficient utilization of carbonaceous wastes will become more prevalent.

There are five major sources of thermal energy for steam generation:

1 Fossil fuel produced or prepared for this specific purpose.

2 Fuel produced as an inherent part of a process whose economic feasibility depends upon utilization of that fuel.

3 Fuel produced as a by-product in a process which does not depend upon its utilization, and where disposal may present a problem.

4 High-temperature flue gas produced by industrial processes.

5 Thermal energy resulting from exothermic reclamation of process materials.

These major sources of fuel, with the exception of fossil fuel, are discussed in relation to the methods of utilization and the processes involved.

By-product fuels, which must be used in order that a process may be economically feasible, are removed from primary fossil fuels for utilization as raw materials in process industries. By-products of coal and their utilization are discussed in relation to a low-temperature carbonization process which utilizes low-temperature char and a high-temperature gasification process which results in a high-carbon solid residue and high-temperature sensible heat leaving the reactor. The heavy residuals from the various petroleum cracking processes are utilized in a number of ways to produce a higher yield of lighter hydrocarbons and a solid residue suitable for fuel. The characteristics of these solid residues vary widely depending upon the process used, and the methods of utilization vary equally as widely. Consideration in this paper is given to such by-products as coke and pitch.

By-product fuels, the incidental products of processes which may have little or no concern with fuel as such, are often disposed of by burning with little or no thought given to the efficient utilization of the thermal energy content. From coal burning these products are often present in the form of coke breeze or as coke-oven and blast-furnace gases. From oil in petroleum catalytic crackers, CO gas is the by-product. Wood—bark, saw and sander dust, slabs, and shavings—and bagasse, the fibrous portion of the sugar cane which is left after the extraction of the juice, are also included in this category.

A brief discussion is presented of by-product high-temperature industrial flue gas containing significant amounts of sensible heat and, frequently, considerable quantities of solid material carried over from the process. Exothermal process material reclamation is also noted briefly.

With improved methods of conservation of natural resources, it is suggested that utilization of these by-products may become standard practice.

Attempts to apply standard types of boiler units, not designed specifically for by-product utilization, can result in ailure. Close co-operation between the operator of the industrial process and the boiler manufacturer can result in steam-generating units which are economical and free from operating problems.

Handling Coal on the Public Service System.....57—A-272

By R. A. Baker, Mem. ASME, Public Service Electric & Gas Company, Newark, N. J. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Continuing research, the goal of which was automatic intermittent feed of fuel, has successfully achieved the advantages sought. Numerous mechanical and electronic devices have been developed and provide increasingly reliable sensing in the bins above the pulverizers and at other spots in the transport system.

An outdoor coal-feed system has been arranged so that coal could be automatically and continuously fed from a large bunker, remote from the boiler, through bins located above the pulverizers. This system places the coal where fires can be extinguished easily, where collection of explosive gases is not a great hazard.

In this new concept, the enclosed bunker is replaced by a large active coal pile located in the center of the existing outdoor long-term storage pile over three new ground-level reclaim hoppers which were built into a reinforced-concrete structure. These storage-pile hoppers feed a series of conveyer belts which are controlled from level in the 4-hr bins immediately above the pulverizer feeders, as in the earlier installations; and a single belt fills the area immediately above the storage-pile reclaim hoppers, just as was done in the case of the bunkers.

The walls of this outdoor bunker, however, consist of three connecting circular rings of coal, which are compacted by tractor and located the proper distance from the hoppers, so that a free-flowing volume of loose coal is located above the hoppers within the confines of the compacted area.

External to the rings is the long-term storage pile made with bulldozer, tractor, and perhaps, in long hauls, with carryalls attached to the tractors. When the supply of river-borne coal is low, tractors bulldoze a sufficient supply into the loose pile over the hoppers, but, of course, under normal river-borne supply the loose active pile is maintained daily by hoisting from barges and conveying over a swing-boom tower.

Operation of the system, including the mechanism for emergency trips; the function of the control room; manual operation; control of the coal to the pulverizers; and the operating experience based on service since May, 1954, are included in the discussion.

Effects of Particle Size on Firing Pulverized Solid Fuels in Boilers... .....57—A-276

By A. L. Bayles, Mem. ASME, Allison L. Bayles and Associates, Pittsburgh, Pa. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Four aspects of particle size of solid fuel which affect the combustion process as it is applied to boilers are discussed largely on the basis of theoretical considerations.

The effect of particle size on falling time indicates that there is valid reason to consider 200 mesh as having significance. Above 200 mesh, coal particles having a high mass-area ratio fall rapidly. The high mass-area ratio causes the particles of burning fuel to settle out or be thrown out of the streams of combustion gases and come to rest on cooler surfaces. The combustion process is arrested by quenching, leaving unburned carbon in the fly ash. In addition, the tendency toward deposition of ash as slag is increased. Problems arising from deposition of fireside residues on surfaces of tubular structures should be somewhat proportional to the quantity of particles greater in size than 200 mesh.

Reactive area in relation to mass is important. The effect of decrease of particle size is significant in increasing the available reactive area of fuel mass.

The size of particles in relation to their capsulating gaseous envelopes might have greater significance than first assumed. The combustion of fuel requires large quantities of gases to support the process. If particles are kept small, the significance of the envelope becomes great. It supports the idea that smaller combustion chambers, uniform rate of combustion, and less unburned carbon are possible without exceeding permissible limitations in other directions.

Smaller coal particles result in smaller ash particles. The practical effect of smaller ash particles is made apparent by the faithfulness with which they follow gas streams despite forces induced by tortuous passages within the tube sections. Conversely, there is decreased tendency for the ash particles to leave the stream and come to rest where they are least wanted and impair the rate of transfer of heat by masking tube surfaces.

A discussion of the effects of particle size in practice attempts to confirm these benefits by example and to demonstrate that the required results can be achieved at a practical cost.

Power

Some Uses of Photography in Engineering.....57—A-155

By W. C. Foulke, Eastman Kodak Company, Rochester, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Still photography has been used successfully as a means of reducing costs in engineering, drafting, expediting, and construction phases of a project. The savings result from a reduction in the number of plant trips and the simplification and clarification of drawings, written specifications, and verbal instructions through the use of photographs.

Some specific engineering and drafting applications where still photography has been used successfully are in equipment location, piping design, supplementing field instructions, aid in preparing free-hand isometric sketches, equipment assembly, conferences, general study work, scale model, bringing file and records up to date, initiating ideas, and simplifying piping drawings.

It is not intended that ordinary snapshots taken by amateur photographers be used for applications requiring professional service of an industrial photography department. Certain engineering applications can be served better by a professional photographer. In most cases, however, ordinary snapshots taken by engineers or draftsmen will serve the purposes discussed in this paper.

With almost no training and with only a relatively small investment in photographic equipment, the use of still photography gives engineers a simplified means of obtaining, transmitting, and recording design information. Although some initiative and perseverance are required initially, design cost savings can be realized by accepting this new technique as an engineering aid.

In order to use this application as an aid, the engineer must use imagination and foresight in his particular work. If the engineer consciously considers photography as an aid for every project during the early establishment of this technique, the use of still photography will shortly become an accepted engineering practice.

Should Ultrasonic Inspection Be Used to Augment Radiography in the Inspection of Weldments in High-Pressure Piping...57—A-195

By R. L. Steele, Mem. ASME, Consolidated Water Power and Power Company, Wisconsin Rapids, Wis. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

In October, 1956, Consolidated Water Power & Paper Company decided to install a 1450-psi 950-F steam plant to provide electrical power and process-steam requirements for paper machine No. 5 at the Biron, Wis., mill. Shortly after the design of this plant was under way the subject of welding inspection of the main steam piping arose. After considerable study it was decided to employ the ultrasonic method of weld inspection if a procedure for inspection could be developed that gave reproducible results and was satisfactory to the insurance carrier and the company.

A procedure is described for the inspection of high-pressure piping weldments employing ultrasonic inspection augmented by radiography.

The data presented in this paper indicate that ultrasonic inspection, augmented by radiography where necessary, for the inspection of high-pressure pipe weldments is a satisfactory inspection procedure. In Part 1 it is shown that root cracks cannot be detected satisfactorily by radiography even though a radiograph of the root pass is made. On the other hand, ultrasonic inspection locates the crack positively, provided that the operator uses sufficient care. Part 1 also demonstrates reproducibility of results with ultrasonic testing.

Part 2 of the paper demonstrates that ultrasonic inspection of field welds is satisfactory. In one case a possible crack was detected, which was very small, which was in no way indicated on the radiograph of the same joint. Possible progression of this defect can be checked easily during an annual outage. Some of the defects indicated in the field were somewhat misleading owing to burn-through. This situation might be corrected by the use of consumable backing rings and backup gas. This would be easy to verify on a job in which this type of welding was employed. It should be mentioned that no repairs were necessary on any of the main steam field

welds. From an operator's point of view this was fine, but from an engineering point of view it would have been interesting to have found a defect which required repair in order to verify completely the findings from both the ultrasonic inspection and radiographs. Perhaps this situation will be encountered in the future.

First Steps With a Digital Computer ..... 57—A-164

By R. H. Gherst, Mem. ASME, United Engineers and Constructors, Inc., Philadelphia, Pa. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Use of an electronic computer for solving one of the most tedious routine problems of an engineering company—pipe-stress analysis—is described.

The grapho-analytical, or moment-area, method of analysis was selected as the basis for the original program because of the ease of calculating the movements of the piping. For this first venture into the field of electronic computation, it was decided to write the program for a three-plane piping system involving only two anchors, as this is the most frequent type of problem. By means of a program supplement it was possible to solve single-plane problems also.

The machine used for this work is described as a large-size, medium-speed computer. Physically, it occupied 31 standard cabinets 7 ft high, arranged in the shape of a hollow rectangle with a perimeter of about 60 ft. Part of one side of the rectangle was open, giving access to a raised platform on which the operating console and the input and output equipment were located. The machine contained more than 3000 vacuum tubes, 7500 germanium diodes, and 5 miles of cable; 33 kw of power and 12 tons of air conditioning were required for operation.

The memory was of the magnetic drum type with storage capacity of 5300 words and speed of 3600 rpm. One teletype tape reader and two photoelectric tape readers were available for input. Output equipment consisted of one teletype page-printer and one high-speed tape punch with page-printer.

The computer contained a number of built-in checking features to insure accuracy. In case of malfunction or faulty data the machine halted and sounded an alarm. The chance of an undetected error was exceedingly small. This possibility was no great source of concern on the pipe-stress problem as most parts of the calculations are self-checking, while in all parts a gross error can be detected readily. If any doubt arose it was a simple matter to repeat the calculations.

Without being a dissertation on analytical procedures or types of computers, this paper describes work which has been done by the author's company in applying electronic computation to the tedious routines of pipe-stress analysis. It discusses the costs involved and the practical limits to which this work may be extended by a consulting firm engaged in general engineering practice. There also are observations on programming and use of a computer based on more than three years of operating experience.

Observed Effects of Deposits on Steam-Turbine Efficiency ..... 57—A-116

By J. Angelo, Assoc. Mem. ASME, and K. C. Cotton, Mem. ASME, General Electric Company, Schenectady, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Deposits on steam-turbine nozzles and buckets have in the past caused deterioration in turbine efficiency. The amount of deposit in steam turbines has been reduced considerably in the last decade. As unit ratings and fuel costs increase, however, the incentive for further progress in this area becomes greater.

The purpose of this paper is to present the results of recent tests conducted jointly by electric utility companies and the authors' company to show the magnitude of the deposit problem as it exists today, and to describe in detail the testing techniques used.

The data taken on eight turbines, all of which used solid boiler-feedwater treatment at one time or other, indicate the following: Units with initial pressures of 1450 psig experience little loss of efficiency due to deposits in the steam path; at initial pressures of 1800 to 2400 psig, there are about 3 per cent loss in high-pressure-section efficiencies, and about 1.5 per cent loss in intermediate-pressure-section efficiencies due to deposits. The resulting loss in over-all heat rate is 1 per cent which is worth $34,000 per year on a 200,000-kw machine, based on 80 per cent load factor and 30-cent fuel. The total value to the electric-utility industry of deposit-free turbine-generator operation based on 600,000,000,000 kwhr generated in 1956 and using the foregoing 1 per cent figure would be about $20 million per year.

These results indicate that about half of the 1.8 per cent gain in heat rate for increasing initial pressure from 1450 psig to 1800 psig may be lost due to deposits in the steam path. Turbines must be essentially as deposit-free at 1800 psig as they appear to be at 1450 psig if the potential fuel saving for the higher pressure is to be realized.

Usually, when the turbines are cleaned thoroughly, either by washing or by mechanical cleaning during an outage, the initial efficiency level is substantially regained, thus indicating that the efficiency deterioration is due to deposits. Cleaning the turbine alone appears not to eliminate the trouble, but it is encouraging to note the improvements made on these particular turbines when corrective measures are taken in boiler feedwater treatment.

The measurement of efficiency of turbine sections operating within the superheated-steam region offers a very accurate and convenient method of determining the presence and effect of deposits in the steam path of a unit and the effectiveness of action taken to eliminate the problem.

Creep, Stress-Relaxation, and Metallurgical Properties of Steels for Steam-Power Plant Operating With Steam Temperatures Above 950 F (510 C) ..... 57—A-255

By A. I. Smith, E. A. Jenkinson, D. J. Armstrong, and M. F. Day, National Physical Laboratory, Teddington, England. Originally presented before The Institution of Mechanical Engineers. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

The committee concerned primarily with steels for steam-power plants is subcommittee *J/E* (Steels for High Temperature) of the Electrical Research Association in Great Britain. This group undertook a series of investigations to provide long-time information on the creep and metallurgical properties of chosen steels. The work was done at the National Physical Laboratory.

The steel chosen for the investigations described in this paper were either taken from production batches of components intended for use in the Central Electricity Authority (CEA) 1050 F plants, or were more highly alloyed $\frac{1}{2}$ per cent molybdenum steel and appeared suitable for use in advanced steam-power plants.

Work is not complete, but tests on all the steels had durations of 20,000–30,000 hr in April 1956, and this paper summarizes the main results available at that time, and includes comments on their interpretation. Some of the creep tests are still in progress and will be continued to provide data for confirmation of tentative extrapolations from shorter times. Fuller reports of the work described in this paper, including more-detailed high-temperature data, are to be published by the British Electrical and Allied Industries Research Association.

The steels investigated were types suitable for turbine casing bolts, steam pipes, superheater tubes, and cast components such as turbine casings and steam chests. They included molybdenum-vanadium, chromium-molybdenum-vanadium, chromium molybdenum, $2^1/_4$ per cent chromium-molybdenum, and chromium-nickel-niobium (18-12-1).

Details of the methods of manufacture, chemical analyses, heat-treatments, and mechanical properties of the steels are tabulated in Appendix I, and only brief descriptions are included in the text.

All the steels were metallurgically examined in their initial conditions, and the changes of microstructure and constitution occurring during prolonged testing at high temperatures have been studied. Although this work is not yet complete (some of the creep tests being still in progress), the observations available are discussed since they are of considerable value in assessing the reliability of the extrapolations of the creep-test results to longer times.

Creep Properties of Austenitic Nickel:Chromium Steels Containing Niobium.....57—A-254

By W. H. Bailey, William Jessop and Sons, Ltd.; M. G. Gemmill, United Steel Companies Ltd.; H. W. Kirkby, Brown-Firth Research Laboratories; J. D. Murray, United Steel Companies Ltd.; E. A. Jenkinson, National Physical Laboratory; and A. I. Smith, Research Laboratory, England. Originally presented before The Institution of Mechanical Engineers. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Three steelmakers have collaborated to collect the laboratory test data obtained in ASME paper No. 57—A-255, "Creep, Stress-Relaxation, and Metallurgical Properties of Steels for Steam-Power Plant Operating With Steam Temperatures Above 950 F (510 C)," on austenitic Ni-Cr-Nb steels. In this paper the data are analyzed and an estimate has been made of the level of properties that may be expected. It is believed that the bulk of the available British long-time data relating to this steel are included in this report.

The data relate to 16 heats of steel, three of which are the heats described in the paper just referred to, and are included for the sake of completeness. On a rupture basis, the tests extend up to 8000 hr at 550 C (1022 F), 42,000 hr at 600 C (1112 F), 41,000 hr at 650 C (1202 F), 26,000 hr at 700 C (1292 F), and 20,000 hr at 750 C (1382 F). On the basis of 1 per cent plastic strain the data extend up to 32,000 hr at 600 C (1112 F), 30,000 hr at 650 C (1202 F), 12,000 hr at 700 C (1292 F), and 14,000 hr at 750 C (1382 F).

A few of the tests were simple rupture tests without measurement of strain, but in the majority comprehensive strain measurements were made. It has been thought sufficient to present only the data relating to rupture and 1 per cent plastic strain, the latter being the most useful single figure for giving an impression of the creep resistance of the material.

The tests, with the exception of those of the tube and pipe steels already referred to, were made by the manufacturers and relate to wrought bars of small diameter ($^5/_8$-1 inch) and to a rotor forging. The range of temperature and stress varied according to the applications in mind when the tests were undertaken, so that there is no uniformity of testing conditions. Since some of the tests have lasted nearly five years, the results describe the properties of steels that were made six or seven years ago.

Croloy 15-15N—An Austenitic Heat-Resistant Alloy for Severe Tubular Applications at Elevated Temperatures.....57—A-205

By J. F. Ewing, The Babcock & Wilcox Company, Beaver Falls, Pa. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

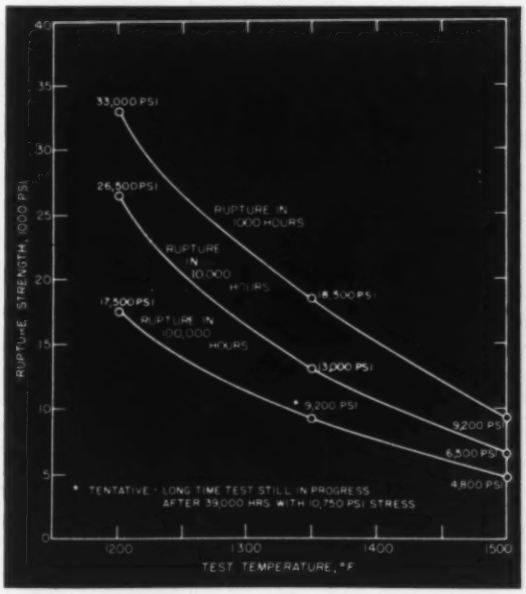
An extensive alloy-development program has been in progress since 1942 in an effort to find alloys capable of withstanding the severe high-temperature requirements needed to obtain successful jet-engine performance in military aircraft. From this program, a large family of complex heat-resistant alloys has evolved, generally referred to as super alloys, which retain high strengths above 1200 F when heat-treated properly.

It would seem that these alloys could find widespread use in industrial applications requiring extreme high-temperature strength. Two factors, however, discourage their industrial use; namely, cost and fabrication characteristics.

These factors prompted the search for an austenitic heat-resistant alloy, primarily for tubular products, which possessed not only strengths superior to the present conventional tubular alloys (AISI Type 300 Alloy Series) but suitable working characteristics to permit manufacture of tubular products by conventional hot-working—rotary piercing, extrusion, rolling, and so on—and cold-working techniques—drawing, sinking, tube-reducing, and such.

Developmental work has been completed on a new austenitic heat-resistant alloy possessing these two characteristics. This new alloy, designated as Croloy 15-15N, was developed initially for tubing applications for high-temperature, high-pressure boiler equipment, or other process equipment requiring strength properties in the temperature range 1200-1500 F in excess of those obtainable for the present AISI Type 200 Series of austenitic alloys.

The chemical composition of Croloy 15-15N is similar to the AISI Type 316 (16 Cr-13Ni-3Mo) austenitic heat-re-



Creep-rupture strength for commercially processed Croloy 15-15N between 1200 and 1500 F. Bar stock solution-annealed at 2250 F for 30 min and water-quenched. (57—A-205)

sistant alloy. Tungsten together with molybdenum and columbium-tantalum has been added to a 15 Cr-15 Ni base for strenghtening.

This paper summarizes extensive test work to evaluate the short-time tensile, creep-rupture, and creep properties of Croloy 15-15N together with structural stability as measured by impact tests after prolonged aging at elevated temperatures. Service experience with Croloy 15-15N is described.

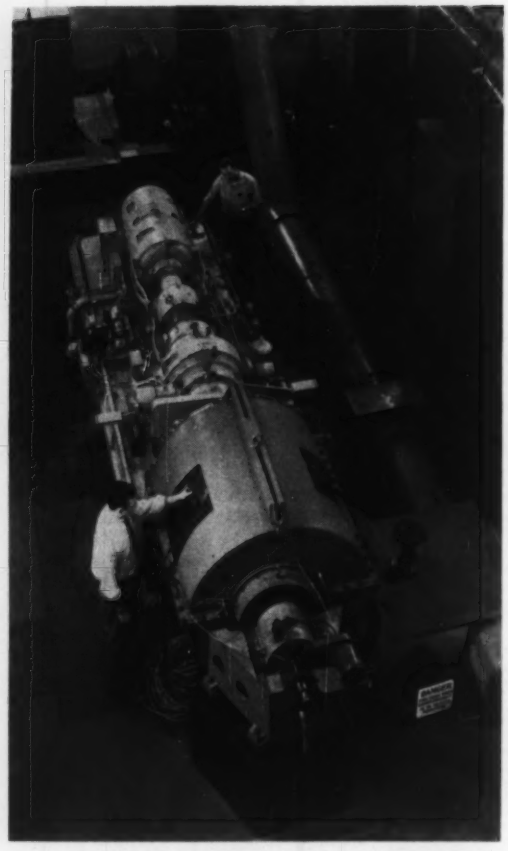
The Development of an Experimental Laboratory for Performance Tests of Steam-Turbine Blading.... .....57—A-163

By F. J. Enright, Assoc. Mem. ASME, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Despite the high level of performance attained in the modern steam turbine, the search for improvements cannot be relaxed. There are still many basic problems concerning the fluid mechanics of turbine blading which are not completely understood, and continuous research and development work on blading performance are necessary to solve these problems in an effort to increase turbine efficiencies.

In 1955, a decision was made at the author's company to supplement the existing test facilities with a modern experimental turbine laboratory. The laboratory was put into operation in June, 1956, and it has been in use for blading performance tests since early this year. The purpose of this paper is to describe the development and initial operation of this facility.

The experimental turbine laboratory was designed to test the type of blading normally used in the high-pressure and intermediate-pressure regions of a steam turbine. Provisions were made to accommodate reaction blading, impulse blading, and governing stages; and the experimental turbine can be used for either single-stage or multistage tests.



Over-all view of experimental turbine laboratory equipment. Turbine can be operated at velocity ratios from about 0.1 to 1.0 when testing reaction blading and from about 0.08 to 0.75 when testing impulse blading. All main instrument lines, electrical lines, and auxiliary pipes are placed in trenches; and the lubrication system for the turbine and dynamometer is in a pit below floor level. Arrangement leaves the floor clear and permits easy access to the turbine. (57—A-163)

The primary requirement of the laboratory was that the test results be suitable for direct use in turbine design. This made it necessary that the flow in the experimental turbine be similar to the flow encountered in commercial turbines, and that the test results be determined accurately so that the data could be used with confidence. In addition to these technical requirements, considerable thought was given to making the laboratory reliable and easy to operate so that as much time as possible could be devoted to testing.

The object of this paper is to discuss the factors involved in the development of an experimental laboratory for testing steam-turbine blading. Considerations affecting laboratory design are presented with a description of the resulting facility—the turbine, the air-supply system, dynamometer, control, and instrumentation.

Initial turbine tests and problems encountered with turbine bearings and dynamometer are outlined. A brief description of a typical blading test completes the paper.

Lubrication

Experiments on Imperfect Lubrication.....57—A-62

By M. D. Hersey, Fellow ASME, Brown University, Providence, R. I.; and C. W. Staples, Socony-Mobil Oil Company, Inc., Paulsboro, N. J. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

A report of certain experiments conducted for the ASME Research Committee on Lubrication is the basis for this paper. The experimental work comprised friction measurements under imperfect lubrication conditions up to loads of 10,000 psi or more. Eight lubricants were compared whose viscosity-pressure characteristics were known. A Kingsbury oil-testing machine was used, with bearing surfaces designed to eliminate hydrodynamic action so far as possible.

A condition of mixed lubricant prevailed, in which rapid wear of brass on steel occurred simultaneously with hydrodynamic effects. All tests were run well to the left of the familiar minimum point on the coefficient-of-friction diagram. Three methods of plotting the data were tried: (*a*) The direct plot of friction per unit area against load per unit area, holding the speed and viscosity constant; (*b*) a conventional plot of the coefficient against Z_1N/P, where

Z_1 is the viscosity at atmospheric pressure, N the speed, and P the load per unit of projected area; and (c) a modified diagram in which each of the foregoing curves is replaced by a family of curves with different values of the pressure-viscosity parameter. This parameter, the product of load per unit area by the pressure coefficient of viscosity, helps to explain earlier discrepancies and to set up a better correlation.

The usual contrast between friction of fatty and mineral oils was confirmed, and it was concluded that boundary lubrication and wear are accompanied by hydrodynamic action on a microscopic scale.

Static and Dynamic Characteristics of Compensated Gas Bearings.....57—A-138

By H. H. Richardson, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

A static and dynamic analysis of a general configuration of a compensated gas bearing is presented for the case in which the effects of shaft rotation on performance are negligible. The equations developed can be used quantitatively and are particularly useful in assessing the effects on static and dynamic performance of changes in design parameters such as fluid properties, compensation schemes, and geometry. To illustrate the use of the equations developed, a comparison is made between two common types of hydrostatic gas bearings—the pool bearing and the inherently compensated bearing—and a design example for a specific bearing requirement is worked.

Viscosity-Pressure Effect on Friction and Temperature in a Journal Bearing.....57—A-66

By S. J. Needs, Mem. ASME, Kingsbury Machine Works, Inc., Philadelphia, Pa. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

The recently published report on investigations conducted by the ASME Research Committee on Lubrication on the increase in viscosity of lubricants with pressure brings up the question of the importance of this phenomenon in actual machine elements. The present tests were undertaken to show differences in friction and operating temperature when heavily loaded partial journal bearings were operated with two different oils in the same viscosity range but of widely different viscosity index and viscosity-pressure characteristics. It is hoped that the results obtained in this short study will lead to more comprehensive investigations, not only in the field of journal bearings but also other machine elements.

Solution of the Tapered-Land Sector Thrust Bearing.....57—A-152

By O. Pinkus, Assoc. Mem. ASME, General Electric Company, West Lynn, Mass. 1957 ASME Annual Meeting paper (in type; to be published in *Trans. ASME;* available to Oct. 1, 1958).

Reynolds equation in polar co-ordinates was solved on a digital computer for the actual sectorial geometry of finite thrust bearings. The oil-film shape is that of a uniform taper in the circumferential direction. Minimum film thickness, side and end leakage, power loss, and centroids are given in general dimensionless form as functions of a dimensionless group $(\mu N/P)(L/b)^2$, where μ is viscosity, N is the speed of the runner, P is the unit loading, L is the radial length of the bearing, and b the amount of taper. A wide range of bearing parameters is covered and solutions are given for very heavy unit loadings. A short discussion is included on how to perform thrust bearing calculations using the results and expressions derived in the paper.

Production Engineering

The Use of Numerically Controlled Machine Tools.....57—F-14

By M. V. Hayes, Jones and Lamson Machine Company, Springfield, Vt. 1957 ASME Fall Meeting paper (multilithographed; available to July 1, 1958).

Numerically controlled machine tools are machines which are put through a series of operations by means of tapes or punched cards instead of human operators.

Numerically controlled machine tools show up to particular advantage in three areas:

1 They are useful in making objects, like prototype products, dies and fixtures, which have not been made before, for which no tooling exists, and where one is going from engineering drawings or specifications to metal for the first time. They are useful here because the control tape is prepared directly from the drawing. In fact, a tape can be prepared from a table of dimensions or offsets without needing even a drawing, let alone tooling or templates. A numerical control tape can be a direct bridge from the designer's mind to the actual metal.

2 They are useful in producing objects in small quantities where expensive tooling and jigs would not be justified. The tape takes the place of the tooling and jigs, and is much cheaper.

3 They are useful in producing objects which are manufactured in small lots at one time (even though the total number produced may be substantial) where the cost of setting up conventional machines and of storing jigs is high. A tape-controlled machine has no stops or hand controls to be set up, and a tape is easily and cheaply stored compared with a fixture.

They do not show up to best advantage in mass-producing objects directly. For mass production it is usually desirable to go to special-purpose multiple-tool setups and to high-production processes like stamping, broaching, and the like, which do not lend themselves to numerical control. However, one stage removed from actual mass production, numerical control does show great promise in producing dies, jigs, and tooling for mass-production processes.

Technical problems, arising in the use of numerically controlled machine tools, are discussed, including tape programming, tool setting and changing, tool wear and breakage, inspection, chip removal, loading and unloading, and machine maintenance.

Production-Stabilization Problems in Photographic Processing.....57—A-131

By J. M. Allderige, Eastman Kodak Company, Rochester, N. Y.; P. Caris, Palo Alto Processing Laboratory, Palo Alto, Calif.; and W. H. Michie, Eastman Kodak Company, Rochester, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Basic characteristics of the demand in the photographic-processing industry intensify the production stabilization problems of the individual processor. Since photographic processing is essentially a service industry, the product in process is the property of the consumer, and rapid service is an important characteristic of the demand. Further, since amateur "picture taking" is rather seasonal and emotional, the demand for processing fluctuates highly from season to season and within seasons. These two factors complicate the planning of work throughout the industry. Service and cost, continuously, are in conflict.

Service suggests greater numbers of people, while cost suggests having fewer people on hand.

The cost-service conflict only exists because of basic human considerations. If people were employed and released in response to demand, there would be no problem. However, men and women permanently employed play an immeasurable part in higher quality and productivity.

In order to help resolve the problem, a mathematical approach was taken to quantify the cost-service relationship. Mathematical models are formulated for work flow, service, and labor load.

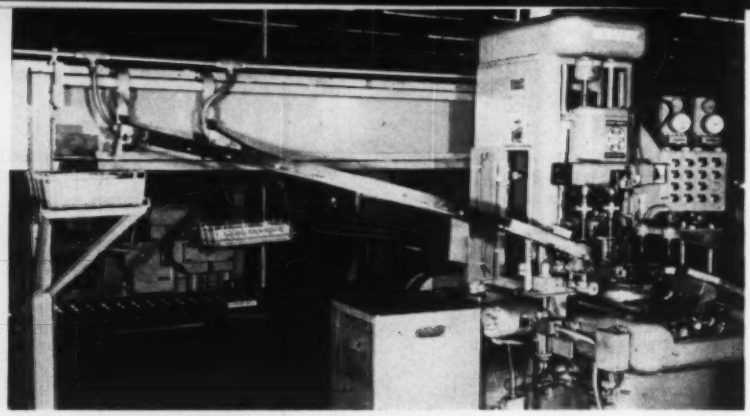
The output of the system—service to the customer—is calculated using the first "work flow" model, then the "service" model. The input to the system is the cost of having the required people on hand. The "labor load" model is employed to calculate this input. The parameters of these models represent such items as lag times, delay times, machine speeds, operation rates, proportions of work to work centers, arrival times of work at work centers, and so forth. All data are control charted, insuring the stability of the inputs to these calculations.

Storage Problems Within and Surrounding an Integrated Line—Partially Automated.....57—A-240

By C. D. Leslie, Whirlpool Corporation, Marion, Ohio. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Storage problems of an integrated line for the fabrication, finishing, and assembly of home clothes driers are the concerns of this paper. The integrated line incorporates both the "batch" and "process" type operations, some of which are automated. The storage problems discussed are of the entire process combined as an integrated system. The system is divided into five main areas: Fabrication, base paint, finish paint, subassembly, and final assembly line.

The utilization of storage conveyers, storage racks, and marshalling areas is discussed as solution to storage problems



Hone operation automatically loaded by storage conveyer. In this automatic conveyer system approximately 30,000 pieces of work-in-process between operations can be maintained. Use is made of strategically placed storage units. (57—A-214)

experienced in this plant. Explanation is made of the method of establishing the bank sizes for automated lines containing special equipment. The variable-speed assembly line, with constant manpower, is described as it relates to the requirements of service and storage conveyers feeding it.

Steps Taken by One Medium-Size Foundry to Meet Today's Competition.....57—A-242

By C. H. Ker, Dalton Foundries, Inc., Warsaw, Ind. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Changes that have been made to improve the operations of the malleable and gray-iron foundries of Dalton Foundries, Inc., are presented. Improvements are best reflected in the number of man-hours required to produce a ton of malleable castings; this figure was reduced in the period between 1941 and 1957 from 81.2 to 44.2

Quality castings, selective selling, and low costs were the guiding principles of the program.

Steps taken to improve quality included the installation of a chemical and physical laboratory, and a complete sand testing laboratory. Efforts have been made to work with the customer to obtain the most advantageous pattern equipment and casting design possible.

Efforts to improve production facilities include the substitution of mechanized equipment for manual operations and handling.

Solving the Storage Problems in an Integrated Process.....57—A-214

By D. R. Cowdrey, Chrysler Corporation, Detroit, Mich. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

One of the paramount problems that must be clearly defined and solved in planning for integration of manufacturing operations is that of providing for work-in-process flow during periods of individual station or operation down time. Otherwise, the savings in material handling and storage gained by integration can be offset or even outweighed by the cumulative loss of production time on the whole series of component operations which form the process line by interruption by a single work station. The solution of this problem of "work-flow insurance" is dependent upon the variables involved, such as product size, available floor space, and anticipated schedule fluctuations. These factors are in addition to the predictability of the frequency and location of down-time occurrences. The assignment of standard time estimates to the elements of down time is required before an accurate estimate of storage requirements can be calculated.

Safety

The Why of Safe Design or Why Safety Engineering in Design?.....57—F-35

By J. V. Grimaldi, Mem. ASME, General Electric Company, New York, N. Y. 1957 ASME Fall Meeting paper (multilithographed; available to July 1, 1958).

Equipment and facilities designed to conform with regulative and authoritative safety requirements will rarely become an entry on an accident report. The only remaining necessities for accident prevention would be to train and interest people in the correct operation of the equipment.

The safety engineer acting as a consultant can offer: Knowledge of accepted safety codes and standards; wisdom in the ways of accident causation and the means for control; counsel that is unprejudiced with respect to the material, but biased with respect to accident-prevention needs; control of the normal inclination to be indifferent to safety.

Materials Handling

Waiting-Line Models in Materials Handling.....57—F-25

By H. P. Galliher and R. B. Fetter, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME Fall Meeting paper (multilithographed; available to July 1, 1958).

A method of "waiting-line models" is applied in solving two kinds of materials-handling problems. The first concerns the use of individual materials-handling units to transport goods between producing centers in a factory. The second concerns the design and utilization of automatic conveyers. In order to clarify how the system of waiting-line models applies to such steps as waiting time, queue size, and probability of delay, a detailed discussion of the first problem is given.

Such terms as calling rate, probability distribution, calling interval, handling time, and handling discipline are defined. The definitions illustrate the many abstract features which many materials-handling situations have in common, and are effective in determining the type of waiting-line model to be used and the kind of data which must be gathered to use the model.

Cost Advantages of Bulk Handling Citrus Through the Packing House.....57—A-101

By R. V. Phillips, Haines City Citrus Growers Association, Haines City, Fla.; and W. Grierson, Citrus Experiment Station, Lake Alfred, Fla. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Experience has shown that citrus fruit destined for the fresh-fruit trade can be handled successfully in bulk. The savings resulting from this method have been six to seven cents per 90-lb box during harvesting operations and a further two to three cents saving within the packing house. In this operation, no field boxes are used; instead, the fruit is picked in small carts. Each cart holds 25 boxes. Two pickers work together to fill one of these small carts. The foreman normally rides a tractor and has one spare cart. When a cart is full, the foreman replaces it with his empty cart, and takes the full cart to the side of the grove where a semitrailer with a vertical field loader is waiting. This vertical field loader is a Haines City development that has caused great interest. In this type of loader the fruit is lifted gently in baskets instead of being scraped up an inclined plane, as is usually the case.

The semitrailer has special baffles at the front end so that the first lot of fruit which enters shall be let down gently onto the floor of the truck. Thereafter, the loader moves along slowly, building off the top of the existing load.

At the packing house, the semitrailer delivers its fruit through doors in the side of the trailer directly onto a belt. The fruit is presized and pregraded before entering the packing house.

In the house, the fruit enters special bins, which have approximately a 200-box (Florida field box has a capacity of 4800 cu in. or approximately 2 1/4 U. S. bushels) capacity. Here the fruit can be held or degreened according to the season. These bins have baffles of soft cloth which hold the fruit to be degreened easily. They work just as well as the regular degreening rooms.

Checks by both the Citrus Experiment Station and by the staff at Haines City have shown that bulk handling when properly used can result in less damage to the fruit than the normal operation using field boxes.

Work Sampling Applied to Material Handling.....57—A-96

By W. J. Richardson, Mem. ASME, Lehigh University, Bethlehem, Pa. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Work sampling is a formalization of the sound supervisory practice of forming opinions from a large number of tours of the work area. It also is a recognition of the fact that all work measurement is a form of sampling. For the measurement of irregular activity, work sampling is not as good a tool as some other techniques. But, in the field of material handling, there is much more noncyclic work than repetitive work and much less history of work measurement. Further, fewer standards engineers and time-study men are assigned to material handling, and thus a technique such as work sampling holds much appeal.

A typical example of work sampling to analyze material-handling activity in a large machine shop engaged in the manufacture of specialized heavy equipment for chemical and power-generation usage is described in this paper.

Pinning Down the Cost of Materials Handling.....57—A-267

By Frederick Golden, United Merchants and Manufacturers, Inc., New York, N. Y. 1957 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1958).

Justification for materials-handling projects includes the identification of both direct and indirect costs created by handling operations. It is necessary to make such identification in order to set up cost controls over handling and to avoid unjustified purchases. A check list of cost factors involved in materials is given, with some items illustrated by a case history. The list includes such items as: Handling within a direct-labor operation, resultant loss of efficiency due to fatigue, possibility of increased accidents; fringe benefits for all handling labor; accidents resulting from heavy lifting; costs of carrying devices; and many others. Methods of determining handling costs are described briefly. Key observation points in the evaluation of the economics of a handling project are noted.

Vertical field loader takes citrus fruit from picking cart to semitrailer. Fruit is lifted gently in baskets instead of being scraped up an inclined plane. (57—A-101)

Applied Mechanics

Stress Distribution Around a Circular Inclusion in a Semi-Infinite Elastic Plate.....57—A-18

By E. M. Saleme, Universidad Nacional de Tucuman, Tucuman, Argentina. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

An exact two-dimensional solution in series form for the stresses and displacements around a circular inclusion perfectly bonded to a semi-infinite elastic plate is presented. At infinity the plate is assumed to be in a state of uniform tension parallel to the straight boundary. It should be emphasized, however, that the method of solution presented may be applied to other types of loading. Numerical results are given for the variation along the axis of symmetry of the normal stress which is parallel to the straight boundary, for a given geometry and various ratios of the elastic moduli of the plate and the inclusion. Finally, the known solutions corresponding to an infinite plate with a circular inclusion and to a semi-infinite plate with a circular hole are obtained as limiting cases.

Thermal Stresses in Transversely Isotropic Semi-Infinite Elastic Solids .....57—A-22

By Brahmadev Sharma, Saugor, Madhya-Pradesh, India. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

While the solution of problems of thermal stress in two dimensions has been considered in great detail, comparatively little work has been done on similar problems in three dimensions. The aeolotropic media have attracted even less attention because of greater difficulty of problems involving more than two elastic constants.

A general method of solution of the steady-state thermal-stress problem of a transversely isotropic semi-infinite elastic solid is given in this paper.

Co-Ordinates Which Uncouple the Equations of Motion of Damped Linear Dynamic Systems..... .....57—A-86

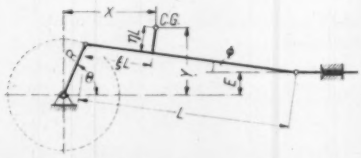
By K. A. Foss, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

Orthogonality relations between the eigenvectors of damped linear dynamic systems with lumped parameters are derived; and from these relations co-ordinates are found in terms of which uncoupled equations of motion can be written. Methods are developed for determining transient stresses in terms of these co-ordinates. The present treatment is extended to systems involving transient damping and to continuous systems.

Unbalanced Inertia Forces in Slider-Crank Mechanisms of Large Eccentricity.....57—A-41

By Ernst Mewes, Institute for Fundamental Research in Agricultural Engineering, Braunschweig, Germany. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

An analysis of the various harmonic orders of the inertia forces in offset slider-crank mechanisms is presented. The formulas given here are valid for all practical values of eccentricity ratio (ratio of offset to length of connecting rod) and crank to connecting-rod ratio.



Eccentric slider-crank mechanism with a connecting rod whose center of gravity (C.G.) does not necessarily lie on the line connecting the bearing centers (57—A-41)

The influence of the latter ratio on the force components is evaluated with infinite series, whereas such is not the case for the eccentricity ratio. Rules for the full or partial balance of harmonic components of the first or any other single order are given.

A Compressible Elastic, Perfectly Plastic Wedge.....57—A-38

By D. R. Bland, University of Manchester, Manchester, England; and P. M. Naghdi, Mem. ASME, University of Michigan, Ann Arbor, Mich. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

This paper is concerned with a compressible elastic-plastic wedge of an included angle $\beta < \pi/2$ in the state of plane strain. The solution, deduced for an isotropic nonwork-hardening material, employs Tresca's yield criterion and the associated flow rules. By means of a numerical example the solution is compared with that of an incompressible elastic-plastic wedge in one case ($\beta = \pi/4$) for various positions of the elastic-plastic boundary.

ASME TRANSACTIONS

THE February, 1958, issue of the *Transactions of the ASME* (available at $1 per copy to ASME members; $1.50 to nonmembers), contains the following technical papers:

Designing Thermcouples for Response Rate, by R. J. Moffat. (57—GTP-8)

Analysis of Incompressible, Nonviscous Blade-to-Blade Flow in Rotating Blade Rows, by J. J. Kramer. (56—SA-66)

Two-Phase Flow in Rough Tubes, by D. Chisholm and A. D. K. Laird. (57—SA-11)

Laminar Flow Over an Enclosed Rotating Disk, by S. L. Soo. (57-SA-28)

Influence of Various Grinding Conditions Upon Residual Stresses in Titanium, by P. A. Clorite and E. C. Reed. (57—A-44)

A Tool-Work-Thermocouple Compensating Circuit, by K. J. Trigger, R. K. Campbell, and B. T. Chao. (56—A-90)

On the Theoretical Analysis of a Dynamic Thermocouple, by E. W. Gaylord, W. F. Hughes, F. C. Appl, and F. F. Ling. (56—A-86)

Temperature Distribution at Tool-Chip and Tool-Work Interface in Metal Cutting, by B. T. Chao and K. J. Trigger. (56—A-87)

Transient Interface Temperatures in Plain Peripheral Milling, by D. E. McFeron and B. T. Chao. (56—A-89)

Experience With Chromium-Molybdenum-Vanadium Steel in High-Temperature Bolting

On the Bounds of Eigenvalues of a Clamped Plate in Tension..... .....57—A-32

By R. K. Kaul and S. G. Tewari, National Physical Laboratory of India, New Delhi, India. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

In this paper, use is made of Temple's generalizations of Kato's theorem for the determination of close lower bounds to the fundamental frequency of oscillation of a clamped square plate subjected to uniform biaxial edge tension. The success of the method depends upon the solution of an auxiliary problem governing the residual mode shape; and in the present case, this mode is determined by using the variational method of Ritz. The principle of computation of the number ϵ_v^2 (which corresponds to the ratio of the elastic energies in the residual and the tentative mode) is explained, and the value of the lower bound is determined by using the inequality $(1 - \rho/\beta(\rho/\alpha - 1) \leq \epsilon_v^2$. The results are compared with those obtained previously

Applications, by R. G. Matters and C. D. Dickinson

The Heat-Balance Integral and Its Application to Problems Involving a Change of Phase, by T. R. Goodman

The Biotechnical Problem of the Human Body as a Heat Exchanger, by L. P. Herrington. (57—SA-5)

Transient Free Convection From a Vertical Flat Plate, by Robert Siegel. (57—SA-8)

Heat Transfer Between a Flat Plate and a Fluid Containing Heat Sources, by I. R. Whiteman. (57—SA-4)

On the Stagnation of Natural-Convection Flows in Closed-End Tubes, by Simon Ostrach and P. R. Thornton. (57—SA-2)

A Model Method for Determining Geometric Factors in Solid-to-Solid Radiation Heat Transfer, by P. L. Tea, Jr., and H. D. Baker. (57—SA-10)

Measurements of the Total Absorptivity for Solar Radiation of Several Engineering Materials, by Richard C. Birkebak and J. P. Hartnett. (57—SA-27)

Similar Solutions for Free Convection From a Nonisothermal Vertical Plate, by E. M. Sparrow and J. L. Gregg. (57—SA-3)

Laminar Mass and Heat Transfer From Ellipsoidal Surfaces of Fineness Ratio 4 in Axisymmetrical Flow, by Shao-Yen Ko and H. H. Sogin. (57—SA-44)

Investigation of Burnout Heat Flux in Rectangular Channels at 2000 Psia, by H. S. Jacket, J. D. Roarty, and J. E. Zerbe. (57—SA-6)

Properties of Friction Materials, I, by P. R. Basford and S. B. Twiss. (57—SA-96)

Properties of Friction Materials, II, by P. R. Basford and S. B. Twiss. (57—SA-97)

Self-Excited Vibrations of an Air-Lubricated Thrust Bearing, by L. Licht, D. D. Fuller, and B. Sternlicht. (57—LUB-2)

A Simple Formula for Determining the Position of Maximum Slider Velocity in a Slider-Crank Mechanism, by Ching-U Ip and L. C. Price. (57—S-8)

Some Methods for the Structural Design of Wings for Application Either at Ambient or Elevated Temperatures, by J. W. Semonian and R. F. Crawford

Analysis of the Transient Response of Nonlinear Control Systems, by P. E. W. Grensted. (57—IRD-8)

Algebraic Approach to Design of Automatic Controls, by Rufus Oldenburger. (57—IRD-2)

Statistical Treatment of Sampled-Data Control Systems for Actual Random Inputs, by Masahiro Mori. (57—IRD-10)

Optimization of Time-Varying Linear Systems With Nonstationary Inputs, by Marvin Shinbrot. (57-IRD-3)

Design of Multivariable Optimum Filters, by J. H. Westcott. (57—IRD-11)

Design of a Self-Optimizing Control System, by R. E. Kalman. (57—IRD-12)

Correlation Functions and Noise Patterns in Control Analysis, by Herman Thal-Larsen. (57—IRD-6)

An Analog Study of a High-Speed Recording Servomechanism, by J. W. Schwartzenberg. (57—IRD-9)

Dynamic Study of an Experimental Pneumatic Process-Pressure Transmitter, by E. F. Hochschild. (57—IRD-7)

The Time and Temperature Dependence of Thermal Stresses in Cylindrical Reactor Fuel Elements, by K. R. Merckx

by Weinstein and Chien, and it is shown that the present method leads to much closer bounds.

Torques on a Satellite Vehicle From Internal Moving Parts....57—A-39

By R. E. Roberson, Assoc. Mem. ASME, Autonetics, Division of North American Aviation, Downey, Calif. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

Many of the torques produced by the motion of parts within a body are negligibly small in most engineering applications. However, if the body is a satellite vehicle, these small torques can be significant, even to playing a dominant role in the excitation of satellite attitude motions. This paper derives a complete expression for the attitude perturbation torque from this source, interpreting each of its terms. The attitude reference co-ordinate system is discussed. The nature of the torque is found for three simple cases.

Axially Symmetric Motions of Thick Cylindrical Shells..57—A-19

By I. Mirsky, Foster Wheeler Corporation; and G. Herrmann, Mem. ASME, Columbia University, New York, N. Y. 1957 ASME Annual Meeting paper (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1958).

An approximate theory of axially symmetric motions of thick, elastic, cylindrical shells, in which the effect of transverse normal stress is retained, is deduced from the three-dimensional theory of elasticity. The present theory contains, in addition to the usual membrane and bending terms, also the influence of rotatory inertia and transverse shear deformation. Thus it may be specialized to a variety of shell, plate, and solid-cylinder equations. The propagation of free harmonic waves in an infinite shell is studied on the basis of the present theory and the three-dimensional theory of elasticity. Excellent agreement is obtained for the phase velocity of the lowest mode of motion for a wide range of the parameters involved.

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COMMENTS ON PAPERS

The Engineering Shortage

To the Editor

NUMEROUS are the reports that Russia is turning out many more "engineers" than are we.

With an illiteracy here of five to ten per cent it is not surprising to find that eight out of ten people one encounters will say that the man operating a diesel locomotive is an engineer; so is the man designing the proposed New York Narrows Bridge. This limited understanding of the engineering profession, being true here, one asks: Do the Russians with 40 per cent illiteracy, know the qualifications—or definition—of an engineer sufficiently to say whether the graduates, be they crane operators, bridge designers, or mathematicians, should be classified as engineers?

It seems quite possible that our limited number of engineering graduates have not had the training best fitted to our industrial needs and we are aggravating the shortage by not adapting courses to the quality of minds available.

One of our most prominent technical institutions has introduced into its mechanical-engineering curriculum a course in molecular engineering. While the writer has a limited knowledge of such a course, one cannot conceive of its being understood without allied courses in advanced chemistry, nuclear physics, and electronics, even biology. All except the latter require advanced mathematics. It is generally agreed that our technical men, unless they are to be researchers, need more collegiate training in the humanities. Does not all this build up a load for potential engineers that can be carried only at the expense of actually needed basic instruction for most of them?

Now, if it is attempted to cram these additional subjects into a four-year curriculum, it will be found that only the geniuses can master the courses. In five years the limited number of near geniuses can also complete the courses. Does this mean that undergraduates will be limited to geniuses and near geniuses? In view of the great number of graduates of the past who have been successful as engineers and managers and public citizens who were not geniuses, it seems quite wrong to so limit the undergraduates. Best relegate the higher mathematics requirements to postgraduate work. My own experience in a half century of general mechanical and civil engineering practice indicates that not ten per cent of the men in similar work would need molecular engineering in their practice.

The present cry for more engineers is based on a real need. There also is a need for the scientist type of engineer, but the type needed in quantities is the constructive engineer of strong personality, vision, ability to communicate ideas to less educated associates, and who are happy and contented in the many jobs where facility in higher mathematics and molecular engineering are little needed. They, of course, must be aware of highly mathematical solutions and know where to turn for aid along these lines.

I know little of psychology and probably the experts in this field would scorn the figures being used, but for want of something better, some recently published I.Q. figures are cited.

The population of this country classifies about as follows:

I.Q.	Classification	Per cent
140 up	Very superior	1
120 to 139	Superior	11
110 to 119	High average	18
90 to 109	Average	46
70 to 89	Low average	21
Below 70	Defective	3

It seems reasonable that these proportions would apply rather closely to the adolescent population. Further, that the three upper classes could be considered possibilities for engineering; a total of 30 per cent of the list. If my estimate of the curriculum of proposed highly mathematical engineering courses is correct, for the program in four years, only the one per cent, very superior, could complete it. In five years, perhaps, ten times the number; but only one third of the engineering material.

Our society needs a certain number of the 130 I.Q. and up in engineering as leaders. For each of these there is needed ten to 20 in engineering with 110 to 130 I.Q., who are "doers" and constructors. The introduction of too many specialties in the courses will make for neglect of the basic engineering principles and "Newtonian" physics that the doers need.

As an "old grad," encountering many types of engineering in my half century of practice and never progressing in mathematics beyond calculus, scarcely rated as high, I can remember only twice when facility in calculus would have been of use. At both those times I was so rusty on the subject that I did not dare attempt such a solution and solved my problem by less direct means.

Let us not make the undergraduate requirements of our best technical schools so high that those who can become high-grade engineers will be ruled out because the courses are fitted only to those qualified to become scientists.

George R. Wadleigh.[1]

Electronic Data Processing

Comment by J. L. Bauer[2]

NOTING the attention of the audience to the three speakers on control through electronic data processing,[3] my discussion amounted to a request for a show of hands on the question, "How many are present because you had noted this par-

[1] Consulting engineer, New York, N. Y. Mem. ASME.

[2] Chief engineer, The Mosaic Tile Company, Zanesville, Ohio. Mem. ASME.

[3] "Electronic Data Processing Machines," by D. H. Ware, W. J. Martiny, and F. J. Maginniss, MECHANICAL ENGINEERING, July, 1957, vol. 79, pp. 632–633, condensed from ASME Paper No. 57—MGT-2.

ticular session when you received the announcement of the conference?"

I would estimate that 80–90 per cent of the large attendance raised their hands, a terrific evidence of the interest in EDP by engineering management.

In conversations with others present at the session, I gathered that most believed they knew less about the problems of EDP following the session. Rather, they now understood how large the EDP problem could be and how little they understood. This seems to point up a need for further discussions at the manager's level of the approach to EDP, how to prepare for it, and what are the differences affecting choice between the various systems offered.

Managers are not interested in the details of operating EDP, but came to the conference hoping to learn how their organizations can profit from processes that EDP can do, but which they do not even dream of doing now. They need to learn how to evaluate such a profit, and balance it, not against how it might be done if it could be done by longhand, but against present operations and present costs.

Take the case of scheduling production. The petroleum refiner with a staff of 100 process accountants working out longhand, by trial and error, how to schedule or process most economically a crude oil received, could put dollars on the accountants relieved. Besides the refiner knows that EDP can evaluate all possible "trials" without the "errors," and perform the job while the tanker is being discharged. The manual process involves days and even weeks before a decision can be reached. Here was a boost in quality of information as well as a possible saving of dead-tankage time.

On the other hand, my own company, and I would say the majority of industry, schedules by incoming orders. Little or no thought is given to economic lot size, sequence of lots, choice of process machinery, and the like. Can we jump into programming our scheduling, or must we first improve our manual system to approach manually the EDP method?

Author's Closure

In his comments on our paper,[3] Mr. Bauer has raised the question whether persons not familiar with electronic data processing methods can jump right into programming of their data processing problems, or whether they must first improve their manual methods. One characteristic advantage of the use of EDPM in almost any field of endeavor, whether it be in the designing of electrical equipment, the mathematical solution of equations, or the financial operations of a business, is that use of the new equipment demands a re-evaluation of methods and techniques. Almost inevitably, it has been necessary to revise currently used techniques in order to reap the greatest rewards from going to the new processing system.

The change-over from manual methods to an EDPM system affords the opportunity for an over-all look at techniques which may have grown with the business and may no longer represent an efficient method of performing such operations. Indeed, many users of EDPM claim to have saved the cost of the equipment purely from the benefits of the improved techniques and these benefits would have accrued even if they had continued to do their processing manually.

The fact that revised techniques are needed with the advent of high-speed data processing equipment calls for a knowledge both of the processes being programmed and of the equipment for which they are to be programmed. Mr. Bauer says managers are not interested in the details of operating EDP but want to learn how their organizations can profit from processes that EDP can do. It seems evident that someone in the organization must be familiar with both of these aspects of the problem, and it would appear from past experience that the form of this education should be in indoctrinating personnel familiar with the problems into the intricacies of the data processing machines.

In the example Mr. Bauer cites, where manufacturing scheduling is done largely by incoming orders, two major considerations are appropriate.

First, if a scheduling problem is complex and second, where cycle times and service requirements dictate rapid scheduling, then EDPM systems will probably show an advantage when evaluated on the basis of cost and service.

D. H. Ware.[4]
W. J. Martiny.[5]
F. J. Maginniss.[6]

[4] Manager of engineering, medium a-c motor and generator department, General Electric Company, Schenectady, N. Y. Mem. ASME.

[5] Project engineer, computers, medium a-c motor and generator department; General Electric Company, Schenectady, N. Y. Assoc. Mem. ASME

[6] Manager, special engineering investigations, General Electric Company, Schenectady, N. Y.

The Maintenance of Gas Turbines

Comment by Peter R. Broadley[7]

The author is to be complimented on the excellent recapitulation[8] of the operating difficulties experienced by the Union Pacific Railroad in operating 25 oil-fired gas-turbine locomotives. The Union Pacific Railroad is to be complimented for its enterprise and foresight in undertaking the operation of these experimental locomotives.

The operating territory between Council Bluffs, Iowa, and Ogden, Utah, covers 994 miles with a total rise in elevation of 7000 ft which occurs at Sherman, Wyo., at 8013 ft above sea level. Throughout the entire year extremes of heat and cold are to be expected and occur. The terrain makes train handling a problem, with no-load to full-load cycling the order of the day. Excessive slack action caused by the terrain abnormally abuses the motive power on the head end.

In spite of all of these difficulties we find the Union Pacific gas-turbine fleet operating between 130,000 and 140,000 miles per unit per year at speeds 21 per cent faster than assigned diesel power running in the same service.

Analyzing Table 1 we see that 56 per cent of the gas-turbine fleet experienced gas turbine or control defects during the month of August, 1956. Sixty-eight per cent of the failures were caused by malfunctioning of the control apparatus and it would appear that the control and switch gear difficulties experienced in diesel operation are being carried over into gas-turbine operation. The need for steel tubing and straight fittings is highlighted in this group of defects. Failures en route indicate the need for properly designed electrical components to withstand the shock of train operation especially in connection with ignition and flame indicating circuits.

It is important to note that during August, 1956, with a total of 744 hours possible the turbine fleet averaged 432 fired hours or 58 per cent utilization. This is remarkably high.

The illustrations of compressor-blade wear are particularly interesting and the fact that the root cutting occurs on the stator is most fortunate. This is a condition that can readily occur when gas turbines operate over lines where hard-

[7] Director of Research, Locomotive Development Committee, Dunkirk, N. Y. Mem. ASME.

[8] "Gas Turbine Maintenance in Severe Service," by Ross C. Hill, Mechanical Engineering, vol. 79, July, 1957, pp. 639–642.

working steam power has been operated over a long period of years and the roadway ballast has become contaminated with cinders. It becomes obvious that a suitable air cleaner will be necessary in order to extend compressor blade life above 15,000 hours.

The last paragraph of this paper completely summarizes the advantages of the gas-turbine locomotive and should do much to encourage the Union Pacific to extend the use of this type of power on its property as well as to encourage other railroads to adopt similarly powered locomotives.

Comment by L. F. Fougere[9] and J. W. Russ[10]

The author is to be congratulated on his paper[8] which describes quite clearly many of the problems involved in operating and maintaining a new concept of locomotive power-plant. We, the power-plant manufacturer, are always pleased to see discussions such as that given by the author since information obtained through these discussions will improve the art of designing and building gas turbines to the ultimate benefit of all concerned.

It was stated that precise regulation is required to get utmost efficiency from modern machines. We agree that good regulation is necessary. However, with good regulation you also have equipment which may require different maintenance practices than, for example, a steam engine or even a diesel engine. We are always trying to reach a compromise of adequate controls and minimum maintenance requirements.

We would like to show what we are doing or have done to correct apparent deficiencies as pointed out in the paper.

1 Our spark plug leads are insulated with silicone insulation which is the best insulating material we can find for the temperatures at which the leads must operate. The present leads are flexible. When the silicone bakes out from heat and becomes brittle and the leads are flexed in handling, the insulation cracks and breaks down. We are investigating a rigid-type lead with the same insulation in hopes of minimizing if not eliminating the possibility of breaking the insulation. We are developing and will have available for field test in the near future a new ignition system which may prove to be better for locomotive service.

2 It was noted that failures of flare fittings and tubing connections in the pneumatic temperature control system are charged to poor selection of material; namely, copper tubing. It has always been the practice of the gas turbine department to supply stainless-steel tubing for our pneumatic temperature-control systems. Since steel tubing is more difficult to service and work, copper tubing was used at the request of the customer. Because of the difficulties afore-mentioned, all of the copper tubing has been or will be changed to stainless-steel tubing.

Our experience to date indicates that, although the copper tubing contributed to the difficulty, the real culprit was the mounting location of the temperature-control panel. The panel was mounted on the side of the gas-turbine compressor. This subjected the panel to vibrations at machine frequencies. We have come to this conclusion for two reasons. First, our prototype pneumatic temperature-control system was mounted on the floor of the cab and ran trouble free for over a year. Secondly, we experienced bellows failures due to vibratory fatigue on the panels that were mounted on the side of the turbine compressor. This type failure was never experienced on the first system.

All of the control panels have been or will be mounted on the floor of the cab, thereby eliminating the vibration source which has caused trouble with the tubing and bellows. Approximately 20 per cent of the reported road delays during the month of August are chargeable to failed tubing and bellows in the exhaust-control system. We are confident that the relocation of the control panel and the use of stainless-steel tubing will eliminate this type trouble, assuming a reasonable amount of maintenance.

3 It was stated that prior to the application of large vents from the bearing housing on the atomizing air compressor it was possible to blow all the oil out of the lube tank and fail the turbine bearings. Tests which have been run during the past few months indicate that the atomizing air compressor does contribute to pressurization of the lube tank when the seals in the compressor have worn excessively. However, all indications now point to the bearing seals and air seals in the turbine proper as major contributors. If these seals are allowed to run with excessive clearances, it is entirely possible to pressurize the lube tank until all of the oil is blown out. From this, we have learned that seals must be maintained and replaced when necessary at scheduled overhauls.

We are presently redesigning those seals which do not have replaceable teeth so that if a changeout becomes necessary it can be done without having to renew the complete seals. This should result in a substantial reduction in maintenance cost.

4 We are continually searching for better erosion resistant material for compressor blading. We now have several different type blade coatings being tested in service. We are again reviewing the possibility of installing air filters or cleaners in the inlet to the compressor. However, space limitations in a locomotive cab make this extremely difficult.

5 The fuel regulator which had jammed and stripped gears in the drive mechanism led to a thorough study of the tolerance stack up in that particular part of the regulator. The study showed us that the tolerance stack up in the machined parts had to be corrected. This has been done and regulators are being corrected as they arrive in our Salt Lake Service Shop. It should be noted that this is the only time a failure like this has occurred in five years of operation.

6 The wire-reinforced hoses to which the author refers are running on many of our other field machines without any known breakage. However, the hoses do require some maintenance and replacement. In any event, the hoses are not likely to burst with no previous warning causing a sudden shutdown.

This type hose normally becomes porous long before a failure and, therefore, should give an indication that something is wrong before serious trouble actually is encountered.

We believe that one of the major obstacles encountered on the locomotive gas turbines has been the education of gas-turbine people to railroad problems and vice versa. We want to point out that many of the problems which have come up on the locomotives while they have been in service are the type which are difficult if not impossible to solve on a drafting board or with a slide rule. Because of this, many tests have been performed on the 25 locomotives presently running, and many solutions to outstanding problems have been a direct result of these tests. The Union Pacific personnel have been extremely co-operative in helping us perform the tests and collect the data. We are sure that as much co-operation as this cannot help but lead to a successful solution to any problem.

The results of this co-operation and the experience gained with the first 25 locomotives should result in better performance of the (30) 8500-hp GTELS now on order.

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[9] Gas turbine engineering, General Electric Company, Schenectady, N. Y.

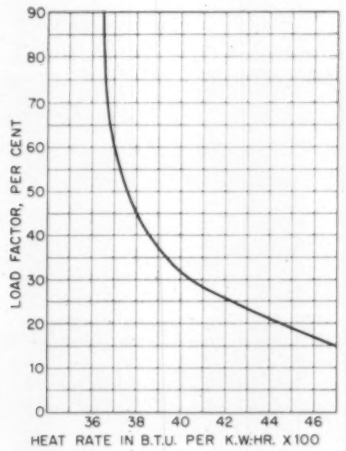
[10] Service engineer, gas turbine department, Product Service, General Electric Company, Schenectady, N. Y.

Industrial Power-Plant Heating

Comment by C. D. Bassett[11]

This paper[12] is well presented and we find it close to our experience with the industrial steam turbine-generator. However, for institutional power plants, such as hospitals, colleges, and the like, where summer loads can easily drop to as low as 15 per cent of rating, the data of Fig. 5 and Fig. 6, particularly Fig. 6, should not be extended by straight line extrapolation to cover the low loads.

Considering a 5000-kw machine, for instance, data from the manufacturer indicate that the K_1 factor is 4700 Btu per kwhr without heat recovery at 15 per cent rated load. If the curve of Fig. 6 were extrapolated as a straight line to 15 per cent load, it would indicate a K_1 of about 3750 Btu per kwhr which would be 950 Btu per kwhr low. Curve of the K_1 factor from 90 per cent down to 15 per cent load is shown in the accompanying graph.



Turbine performance. Curve based on proposal data furnished by Allis-Chalmers for 5000-kw turbine, 7500-kw generator.

Comment by Glenn D. Farrar[13]

The author has done well, exactly what his title[12] says. He has given a practical approach to the allocation of heat. This is a timely contribution for, as he has pointed out, there are many different methods in use today.

He properly has neglected minor details in the derivation of his formula, and has delineated sharply the two major factors: Power made by process steam and power made with steam to condenser.

This paper has meaty thoughts for the designing engineer as well as the operating engineer.

The author has reminded designers of the possible gains that can be made by recovering the heat from oil coolers and air coolers. This is an excellent point that should be implemented in many plants. Of course, where large amounts of heat will be introduced into the circulating water going to a turbine's condenser, the engineer should also evaluate the effects upon the turbine-exhaust pressure.

Fig. 3 vividly shows an example where the heat to process is far larger than the heat required for power generation. This is the usual pattern in industry today when the proper steam-electric balance exists.

There is an important provision in Conclusion 1. This provision is that initial steam conditions are selected high enough to obtain the proper balance.

It is easy to design to a given set of requirements, but it is not always easy to know exactly what the requirements will be over the life of the power plant. After a steam-electric balance is crystallized, and the power-generation equipment purchased, it may be one and a half to two years before it goes into service. Process concepts in fast-moving industries can change significantly in two years. When this happens, the designer may find that his carefully prepared steam-electric balance may not exactly fit by the time the equipment goes into service, and he may find a serious out-of-balance condition during the useful life of the equipment.

It, therefore, is more important that the designer strike a steam-electric balance which is likely to fit a reasonable future condition, than to tie it too tightly to cold facts of the moment.

The most salient factor in historic trends, and particularly in current trends, is that, in nearly all growth-industries, electrical-load increases more rapidly than steam-loads. Where this has been true in the past, it seems prudent to conclude that the trend toward greater electrification will likely continue.

Here is another factor which affects the balance in the same direction. Some industries are finding it practicable and economic to use higher steam-pressure to their processes. This tends to increase the rate of heat transfer, and therefore lowers the cost of process-equipment, For example, in the manufacture of heavy-paper, it was customary in the first part of this decade to use 50 lb steam in the driers. Now, only a few years later, the same kind of paper is made on driers that use 125 lb instead of 50 lb steam. A change of this kind is very upsetting to any steam-electric balance, unless the initial steam conditions to the turbine were established on the high side in the first place.

When the balance is in the fortunate condition of sending only minimum steam to condenser, the author has pointed out in Conclusion 2 the possibility of using a turbine with lower than normal efficiency. This is true if there were any sure way of knowing that the balance would not change. However, in my experience, users have quite consistently had more electrical-load growth than they had anticipated. This future likelihood far outweighs the relatively minor savings of a turbine that has poor efficiency.

The author's formula shows that, as steam-flow to condenser increases, the plant heat-rate goes up rapidly.

By applying boiler-efficiency and auxiliary-load, the formula also can be used to obtain fuel costs.

This paper should be of assistance to many engineers in visualizing their allocations of heat for various conditions, and integrating these allocations into their cost accounting.

Author's Closure

Reply to discussion by C. D. Bassett. The author wishes to express his appreciation to Mr. Bassett for the discussion presented on this paper, but cannot agree with the high value of 4700 Btu per kwhr for K_1 for a 5000-kw turbine operating at 15-per-cent load. Perhaps the significance of K_1 was misinterpreted.

By definition, K_1 is the energy converted from heat to mechanical energy and transmitted to the shaft of the turbine, plus the radiation from the turbine. In other words, it is the equivalent of the electrical energy produced plus the mechanical, electrical, and radiation losses, and is made up of the following components:

1 Radiation losses
2 Friction losses
3 Windage losses
4 Electrical losses
5 Electrical energy produced (3413) Btu/kwhr)

[11] Mechanical engineer, Cummins & Barnard, Inc., Ann Arbor, Mich. Mem. ASME.

[12] "Allocation of Heat in an Industrial Power Plant—A Practical Approach," by R. J. Martin, MECHANICAL ENGINEERING, vol. 79, August, 1957, pp. 743–746, condensed from ASME Paper No. 57—S-10.

[13] Turbine specialist, apparatus department, General Electric Company, Atlanta, Ga. Mem. ASME.

The difference between K_1 and 3413 multiplied by the load in kw will be the total losses. The total losses represented by items 1, 2, and 3 above will be about constant at all loads. The electrical losses (item 4) will increase with increasing load. Therefore the total losses will decrease with decreasing load, and to a lower figure at 15-per-cent load than at 40-per-cent load.

Using the curve (Fig. 6) in the paper we can tabulate the total losses for a 5000-kw machine at several loads as shown below:

If the value of 4700 for K_1 as presented by Mr. Bassett is correct, the total losses at 15-per-cent rated load would be 965,000 Btu which is greater even than the total losses at full load. The value of 4700 Btu per kwhr furnished Mr. Bassett by the manufacturer must include other heat rejected by the turbine, either to the condenser (contained in K_2) or to extraction (charged to process) and cannot be the value of K_1 as used and defined in this paper.

Per cent rated load	KW	K_1	Btu as elec. energy	Total losses
100	5000	3520	17.07 M Btu	545,000 Btu
80	4000	3540	13.65 M Btu	500,000 Btu
60	3000	3555	10.24 M Btu	425,000 Btu
40	2000	3590	6.83 M Btu	355,000 Btu
15*	750	3750	2.56 M Btu	255,000 Btu

* Obtained by extrapolation of curve in Fig. 6.

Reply to discussion by G. D. Farrar. This discussion was read at the Spring Meeting and was very much appreciated. The author agrees with Mr. Farrar's comments. He mentions that one should guard against introducing large amounts of heat to the circulating water to the condenser. This will lower the vacuum and increase the steam rate of the turbine but will have no effect upon heat rate for power generation if all condenser heat is recovered for process.

True, when steam flow to the condenser increases to the point that all heat cannot be utilized for process, the heat rate for power generation increases rapidly.

We have resorted to the installation of high-pressure boilers and topping turbines exhausting into existing steam headers, in order to decrease power generated condensing to the point that all condenser heat is utilized for process, even during summer months.

Acknowledgments. The author wishes to extend thanks to engineers of General Electric Company and Westinghouse Electric Corporation for their cooperation and data furnished for this paper; to Mr. Bassett, Mr. Farrar, and those who discussed this paper verbally at the Spring Meeting; and to members of the ASME for the many courtesies extended to me in Birmingham, particularly to William F. Ryan, ASME President; Ray N. Benjamin, chairman; Joseph W. Eshelman, vice-chairman of the Session at which the paper was presented; and to W. E. Hopkins of the Executive Committee of the Power Division of ASME.

Ronald J. Martin.[14]

[14] Manager of utilities, Beaunit Mills, Inc., Elizabethtown, Tenn. Mem. ASME.

Logic of Organizational Planning

Comment by K. H. Myers[15]

THE author, in this paper,[16] is indeed logical and I could readily accept his conclusions to the effect that centralized organizational planning is necessary for continued growth or even survival, that it is a continuing function of top management, that it requires frequent reappraisal and adjustment, and that formal organizational procedures are often more desirable than informal ones. As a matter of fact, these concepts have long had acceptance in both practice and the literature of the subject. For example, such an enduring edifice as the Roman Catholic Church has practiced the author's recommended course of action for centuries.[17] Military organizations in many countries have also recognized the author's dictums in both practice and theory. The history of thinking in these fields is well documented in a recent work, "Principles of Management," by Koontz and O'Donnell,[18] parts 1 and 2.

Suffice it to say, then, that this writer has no quarrel with what the author has said, rather my criticism is that he concluded where he might well have begun. I should like therefore to propose certain questions relating to the application of the author's concepts. For example:

1 Are there certain fairly common instances where it might be wise to avoid the use of formal organization charts and statements of responsibility, even though all other aspects of his proposals are followed? My own feeling is that the chief executive of a small organization may find that such a practice aids in maintaining morale, encourages initiative, and provides a better growth environment for men of potential top-management ability.

2 What have, in practice, proved to be sound methods of co-ordinating line and staff functions? How far should one go in defining the scope of responsibility in these areas?

3 Are there desirable variations in organizational practice and procedure according to the size of the organization and/or of its various subcomponents?

These questions and others like them may prove fruitful topics for further investigation.

Author's Closure

Thank you, Dr. Myers, for your ready acceptance of my thesis. If the rest of the world were as perceptive as you, I would have done as you desire and begun where I concluded. Instead, I chose this limited, basic approach because of a rather extensive experience with organizations that did not recognize the logic of organizational planning. For example, I can cite a well-known, long-established company, leaders in their field, in which this very paper was widely circulated more than two years ago. They are now in the process of writing the mission of their organization, the step that this paper names as the first to be accomplished on the road to a living, planned organization. Don't people like this need to learn to crawl before we speak to them of running?

As for Dr. Myers' questions:

I can visualize organizations where formal, written statements of relationships and areas of concentration of effort

[15] Associate professor, Production and Personnel Department, Northwestern University School of Business, Evanston, Ill.

[16] "The Logic of Organizational Planning," by T. F. Koch, MECHANICAL ENGINEERING, vol. 79, September, 1957, pp. 836–837, condensed from ASME Paper No. 57—SA-43.

[17] "Principles of Organization," by J. D. Mooney, Harper and Bros., New York, N. Y., revised edition, 1947.

[18] "Principles of Management," by Harold Koontz and Cyril O'Donnell, McGraw-Hill Book Company, New York, N. Y., 1955.

are not necessary, but I find it difficult to generalize about them. Their members would be virtual saints who would willingly step aside when one of their colleagues started to operate in an area normally theirs. They would be trained to take orders from anyone who chose to give them (somehow, without conflicts in schedules). They would have such good communications that there would be no task left undone because one of them chose to discontinue that activity. Alternatively, the organization might be headed by someone who is such a good and patient teacher and has such apt pupils that he, in effect, has had each of his employees commit to memory his organization plan. Do I need to spell out the difficulties and inefficiencies of either arrangement?

This, of course, is not to say that families have not been run along these lines with some success for generations, or that certain voluntary groups cannot manage. However, it has been my experience that formality is mandatory if efficiency is required.

The only sound method I know of for co-ordinating line and staff functions is to assign the staff functions to people with high persuasive abilities, and the line functions to people with open minds and a real desire to seek the best way of accomplishing the greatest good for the organization as a whole. This stems from my understanding that staff people, by definition, can only recommend methods or procedures in their field to the line people, who must, again by definition, be empowered to accept or reject these recommendations.

In my view, when staff people are empowered to issue orders, they become line people and confusion is likely to reign. But this is a subject large enough to require another paper.

Not only are variations in practice and procedure dependent on the size of the organizational component, but on the characteristics of the units that make it up. Thus an organization containing a unit (human or machine) susceptible to frequent breakdown needs to have a different type of procedural insurance against this breakdown than an organization in which the breakdowns are more likely to be either unimportant or final. If Dr. Myers is expecting a formula showing how to vary these practices and procedures with the size of the organization, I shall have to disappoint him. I can only say that given certain known units to perform certain known tasks in a known organizational climate, a planner can devise workable relationships among them in the light of his knowledge. These relationships need not be the same as those devised by another equally competent practitioner whose total experience has been somewhat different.

In summary, the author and the discusser seem to agree the author's recommendations make sense, but they seem to have had contact with organizations in different degrees of development. Also, the discusser has asked three questions and the author has cited his experience and views on these matters. The author has enjoyed the opportunity to expound again on a subject dear to his heart and thanks Dr. Myers for this chance.

T. F. Koch.[19]

[19] Administrative engineer, Chicago Rawhide Manufacturing Company, Chicago, Ill. Assoc. Mem. ASME.

Notes on Books Received in Engineering Societies Library

REVIEWS OF BOOKS

Food Technology

The Application of Physical Sciences to Food Research Processing, and Preservation

Southwest Research Institute, San Antonio, Texas, 1957. Paper, 8½ × 10¾ in., figs., references, v and 179 pp.

Reviewed by D. A. Mills[1]

THIS publication comprises the proceedings of the first food physics symposium held in San Antonio, Texas, March 15 and 16, 1956. The symposium was co-sponsored by the Southwest Research Institute and The Institute of Food Technologists. The former is a private research institute, while the latter is the professional society of food technologists.

The symposium attracted over one hundred American and foreign registrants from industry, government, research foundations, institutes, and universities. Eleven papers were presented by persons of recognized scientific standing in the fields of physics, food chemistry, engineering research, agricultural research, and other related areas.

All papers presented during the symposium are reproduced with accompanying illustrations and each transcript is followed by a discussion and list of references cited by the author. A practical approach was followed by the participants in discussing ways by which the food industry could benefit from the application of physics to food research, production, and packaging.

While the average science or engineering student has been exposed to a physics course consisting of five classical topics (mechanics, heat, light, electricity, and sound), he has probably not obtained therefrom an appreciation of applications to the solution of food industry problems. The student is more apt to have found food application information in his chemistry or biochemistry courses and textbooks. An instance of neglect was observed by one speaker in that the word "food" had not appeared in a recent subject index of 200 pages published by Physics Abstracts. The same speaker then listed 40 recognized fields of physics, citing examples of applications, broadly and specifically, of

[1] Information services supervisor, Research Center, General Foods Corporation, Tarrytown, N. Y.

current or potential interest to agriculture and to the food industry.

The proceedings serve to dispel the notion that physics may be a foreign language in the food industry. On the contrary, the speakers cited numerous examples of the almost limitless potential value of physics (and electronics).

Even the farmer, engaged in cultivating, harvesting, and shipping food produce is consciously or otherwise applying physics in his daily tasks. The modern corporate food processor staffed with research and development, production, and engineering departments, is now applying physics. New developments in automation, however, should engender a deeper appreciation of the technical (physical) aspects of the food industry.

Among the numerous techniques, instruments, and other physical measuring devices used in food research and technology described at the symposium were:

- **Vapor-phase chromatography useful in analyzing flavors.**
- **Irradiation of fresh meat to extend storage life.**
- **Rheological studies of the viscoelastic behavior of dough.**
- **Ultrasonics to destroy bacteria, homogenize milk, and extract flavors.**
- **Radio Frequency Spectroscopy:**
  - ***Nuclear Magnetic Resonance* (NMR) to measure moisture in a variety of food products.**
  - ***Electro-Paramagnetic Resonance* (EPR) to measure free radicals produced by radiation.**
- **Instrumentation to measur the spectral transmission of whole fruits and vegetables.**

The discussion on Food and Science, by Ernest W. Reid, chairman of the board, Corn Products Refining Company, is only one part of the Proceedings which could serve admirably as an educational stimulant. The speaker produced some relationships concerning the number of chemists and physicists employed in all phases of the food industry including research. The percentage is rather small when one considers that nearly one-third of the consumer's dollar is spent for food. It would appear that career guidance workers, vocational counselors, placement directors, and others interested in careers for scientists and engineers would find this talk pertinent to their needs.

It seems a pity to this reviewer that the sponsoring groups did not register the Proceedings with the U. S. Library of Congress, thus assuring its active use by students, researchers, physicists, engineers, librarians, documentalists, literature searchers, and many others who would find the publication enlightening and useful.

BOOKS RECEIVED IN LIBRARY

Bau und Betrieb von Dieselmaschinen
Vol. 2. Die Maschinen und Ihr Betrieb. By Friedrich Sass. Second Edition, 1957. Springer-Verlag, Berlin, Germany. 475 p., $7^3/_8 \times 10^5/_8$ in., bound. DM 75.00. This second volume of a set on the design and operation of diesel engines deals with large marine diesels and their operation. The major part of the volume provides detailed descriptions of the salient features and special characteristics of engines produced by ten leading Continental manufacturers. Separate chapters are also devoted to mechanical balancing, torsional vibration, supercharging, and operational details. The book is particularly well illustrated.

Control of Steel Construction to Avoid Brittle Failure
Edited by M. E. Shank. 1957, Welding Research Council, New York, N. Y. 184 p., $6^1/_8 \times 9^1/_2$ in., bound. $4.50. Prepared by the Plasticity Committee of the Welding Research Council, this compact volume is a general reference and guide for engineers, fabricators, and designers in the structural field. Part 1 deals with the basic concepts and mechanisms of notch brittleness and with the mechanical and metallurgical factors affecting the plastic behavior of structural materials. Part 2 shows how conventional fabrication procedures affect notch ductility of these materials. Part 3 deals with the selection of materials and fabricating procedures; the limits of conventional design methods; and the use of notch-brittle test data. A glossary completes the volume.

The Defect Solid State
By T. J. Gray and others. 1957, Interscience Publishers, Inc., New York, N. Y. 511 p., $6^1/_4 \times 9^1/_4$ in., bound. $11. A collection of papers aimed at focusing attention on the relationship between the defect nature of solids and the various physical and chemical properties they exhibit. The papers, almost all with extensive lists of references, deal with semiconductivity; corrosion processes; magnetic properties of solids; defect structure and catalysis; dielectric materials; phase equilibria; intermetallic compounds; and experimental techniques. One paper is a summary of present knowledge and review of the literature on ceramic materials for high-temperature service.

Deoxidation of Steel
A Memorial Volume to C. H. Herty, Jr. Published, 1957, by the National Open Hearth Steel Committee of the American Institute of Mining, Metallurgical, and Petroleum Engineers, New York, N. Y. Various pagings, $6^1/_4 \times 9^1/_4$ in., bound. $10. A collection of selected papers by C. H. Herty, Jr., emphasizing his most significant work on the physical chemistry of steelmaking. The papers, not generally obtainable today, deal with elimination of metalloids, solubility of iron oxide in iron, deoxidation with silicon and aluminum, the control of oxide in the open hearth process, and with other problems affecting refining reactions and the quality of steel. The volume includes a biographical sketch, a list of his publications and patents, a chapter on the significance of Dr. Herty's work, and short biographical sketches of 37 of his co-workers on the Physical Chemistry of Steel Making project.

Engineering Economy
By H. G. Thuesen. Second Edition, 1957. Prentice-Hall, Inc., Englewood Cliffs, N. J. 581 p., $5^5/_8 \times 8^1/_2$ in., bound. $6.95. The theory and practice of the determination and evaluation of economic factors are here set forth for engineers and engineering students. This edition, in addition to general revision, has a new chapter on income taxes in engineering economy studies. Other subjects treated in the book include: depreciation; first, fixed, variable, incremental, differential, marginal, and sunk costs; break-even and minimum cost points; evaluation of replacements; and economy and utilization of personnel.

Engineering Thermodynamics
By C. O. Mackey, W. N. Barnard, and F. O. Ellenwood. 1957, John Wiley & Sons, Inc., New York, N. Y. 428 p., $5^7/_8 \times 9^1/_4$ in., bound. $7.95. This text covers fundamental principles in its early chapters, but emphasizes applications of fundamentals by devoting separate chapters to air conditioning, refrigeration, gas-engine cycles, and turbines. Also covered are: ideal gas reactions; flow of ideal gases; properties of mixtures of ideal gases; and power cycles of vapors.

Fundamentals of Statically Indeterminate Structures
By Carl L. Shermer. 1957, The Ronald Press Company, New York, N. Y. 264 p., $6 \times 9^1/_4$ in., bound. $6.50. A college text which focuses attention on the basic concepts of statically indeterminate structures. All methods and topics are carefully related and co-ordinated through their development from these fundamental concepts, and the subject is developed as an integrated whole rather than a consideration of numerous unrelated methods. The book is planned so that it may be used as a text in a one-semester or two-semester course.

Gas Chromatography
By A. I. M. Keulemans. 1957, Reinhold Publishing Corporation, New York, N. Y. 217 p., $6 \times 9^1/_4$ in., bound. $7.50. The practical and theoretical aspects of a relatively new type of analysis especially useful in the petroleum and hydrocarbon industries are covered in this concise manual. The methods, said to be quicker than methods such as mass spectrometry, may be applied in various industries including the manufacture of oils, paints, plastics, rubber goods, food products, and chemicals.

Jets, Wakes, and Cavities
By G. Birkhoff and E. H. Zarantonella. 1957, Academic Press, Inc., New York, N. Y. 353 p., $6 \times 9^1/_4$ in., bound. $10. A monograph devoted to the quantitative scientific analysis of jets, wakes, and cavities. The book treats first, in chapters 2–11, the applications of Euler's differential equations to flows with free boundaries, i.e., to liquid flows bounded

by a liquid-gas interface. In chapters 12–14 attention is given to cases of laminar viscous, periodic, and turbulent jets and wakes. Chapter 15 summarizes limitations on deductions made in the first portion of the book. There is an extensive bibliography.

Maintenance Engineering Handbook
Edited by L. C. Morrow. 1957, McGraw-Hill Book Company, Inc., New York, N. Y. Various pagings, 6 × 9¼ in., bound. $20. This comprehensive handbook, containing contributions by more than 80 men, devotes about a third of the book to the management aspects of maintenance, such as organization and administration of maintenance forces, personnel, planning and scheduling, project control, and costs and budgets for maintenance operations. The remaining two thirds of the book covers the selection, installation, and upkeep of buildings; electrical, mechanical, service, and transportation equipment; maintenance stores and their control; lubricants and lubrication; instruments; sanitation; welding; and corrosion. Units of production equipment dealt with include bearings, clutches, chains, drives, gears, valves, etc.

Manufacturing Organization and Management
By H. T. Amrine, J. A. Ritchey, and O. S. Hulley. 1957, Prentice-Hall, Inc., Englewood Cliffs, N. J. 454 p., 6 × 9¼ in., bound. $6.75. Presents in a nontechnical way for the inexperienced person, information on principles and functions of manufacturing management. Although it emphasizes functions usually controlled by the manager, there is also material on marketing, financing, and personnel. Some aspects dealt with are: plant location and layout; design of manufacturing processes; motion and time study; material handling; purchasing; industrial relations; and quality control.

Modern Chemistry for the Engineer and Scientist
Edited by G. Ross Robertson. 1957, McGraw-Hill Book Company, Inc., New York, N. Y. 442 p., 6 × 9¼ in., bound. $9.50. Comprised of lectures by 19 well-known scientists, this book covers a wide range of topics, such as creep of metals, the petrochemical industry, isotopic tracers in chemistry, contact catalysis, column chromatography and stereochemistry, food technology, chemical thermodynamics, and silicones. The treatment varies from discussions of new fundamental methods in kinetics, thermodynamics, etc., to practical technology.

Oil Accounting
By Robert E. Waller. 1956, University of Toronto Press, Toronto, Ont., Canada. 99 p., 6 × 9¼ in., bound. $5.50. An outline of the principles of oil exploration and production accounting practices in Canada, and an examination of the concepts and fundamentals on which they are based. Topics considered are: types of petroleum and natural gas interests and their costs; accounting aspects of divisions of ownership; exploration expenditures; carrying charges on undeveloped properties; exploratory drilling and development of proved properties; production accounting; depletion, amortization, and depreciation; code of accounts; and presentation of the financial statements. Appendix A gives accounting procedure for unit and joint lease operations. Appendix B is a glossary of terms used in the Canadian oil industry.

The Oil Engine Manual
Edited by D. S. D. Williams. Sixth Edition, 1956. Temple Press Limited, London, England. 330 p., 5⅜ × 8¾ in., bound. 18s. Rewritten to cover changes in oil engines in the five years since the previous edition, this manual covers all types of industrial, rail, and road transport oil engines, but does not cover marine applications. Part one deals with general technical aspects, principles, systems, and equipment. Part two gives the leading details of all current makes in the United Kingdom. The appendix includes statistics, standards, and specifications.

Plant and Process Dynamic Characteristics
Published 1957 by Academic Press, Inc., New York, N. Y. 246 p., 5⅝ × 8¾ in., bound. $8.80. The proceedings of a conference held by the Society of Instrument Technology at Cambridge, England, in April, 1956. The 11 papers included are mainly concerned with establishing facts about existing plants and processes in order to develop a basis for the prediction of characteristics of new plants at the design stage. Typical subjects dealt with are an analog computer applied to the study of an operating process-control loop; measuring dynamic response of plant units; and data-reduction equipment as a tool in plant analysis.

Practical Accounting and Cost Keeping for Contractors
By Frank R. Walker. Fifth Edition, 1957. Frank R. Walker, Publishers, Chicago, Ill. 255 p., 8½ × 11 in., bound. $5. The essentials of accurate cost keeping are described for contractors involved in both large and small operations. The book includes complete labor and material cost schedules, information on how costs should be reported from the job, how to gather and compile data from checking the workmen's time on distributing the labor hours, and on working costs into suitable units. Illustrations and descriptions of forms required, i.e., Social Security records, expense sheets, progress reports, estimate sheets, etc., are included.

Procedure Handbook of Arc Welding Design and Practice
Eleventh Edition, 1957. Published by The Lincoln Electric Company, Cleveland, Ohio. Various paging, 5⅝ × 9 in., bound. $3. Provides useful information on all phases of arc welding for the machine designer, the structural engineer, the fabricator, the welder, and all those interested in metal joining. The eight sections cover: history, nomenclature and processes, weldability, mild steel procedures, manufacturing cost data, machine design, structural design, applications, and reference data. The structural section has been completely rewritten and includes the latest data on welded desin. The weldability section includes information on welding such new materials as zirconium and titanium.

Progress in Low Temperature Physics
Vol. 2. Edited by C. J. Gorter. 1957, North Holland Publishing Company, Amsterdam, Netherlands; Interscience Publishers, Inc., New York, N. Y. 480 p., 6¼ × 9⅛ in., bound. $10.75. Fourteen substantial review papers with extensive lists of references summarize the present state of low-temperature research, particularly with reference to magnetism, superconductivity, and liquid helium, but with some attention to other subjects such as various nonmagnetic properties of solids. Topics of some of reviews are: helium films; electron transport phenomena in metals; semiconductors at low temperatures; paramagnetic relaxation; and physical properties of rare earth metals.

Project Engineering of Process Plants
By Howard F. Rase and M. H. Barrow. 1957, John Wiley & Sons, Inc., New York, N. Y. 692 p., 5¾ × 9⅛ in., bound. $14.25. Written to record information and techniques used in plant design and to discuss ideas developed by process engineers, this book is for the project engineer or for any engineer who designs process plants or equipment. The four sections are: major steps in plant design; business and legal procedures; details of engineering design and equipment selection; and construction of the plant. Chemical-engineering plants and equipment are emphaized but some of the material will be applicable to other fields.

Protective Painting of Structural Steel
By F. Fancutt and J. C. Hudson. 1957, The Macmillan Company, New York, N. Y. 102 p., 5½ × 8¾ in., bound. $4.50. This is a concise and simple statement of the best methods for protecting new or old steelwork against atmospheric corrosion by the use of paint alone or by paint used in conjunction with metal coatings. The recommendations are based on investigations carried out by the Protective Coatings (Corrosion) Sub-Committee of the British Iron and Steel Research Association.

Relaxation Spectrometry
By E. G. Richardson. 1957, North Holland Publishing Company, Amsterdam, Netherlands; Interscience Publishers, Inc., New York, N. Y. 140 p., 6 × 9⅛ in., bound. $5.75. "This text deals with those energetic phenomena which accompany the passage of mechanical displacements through matter." [Preface.] The first chapter is a discussion of the nature of acoustical relaxation sufficiently detailed to provide a background for the principal subjects covered: mechanical and electrical models; the infrasonic, sonic, and ultrasonic spectra dielectric relaxation; and spectrum analysis. The emphasis throughout is on experimental methods, with only a minimum of theory introduced.

Russian-English Atomic Dictionary
By Eugene A. Carpovich. 1957, Technical Dictionaries Company, New York, N. Y. 317 p., 5⅞ × 8½ in., bound. $12. Contains over 23,000 Russian entries primarily in nuclear science and nuclear technology including atomic and molecular physics, pure and applied mathematics, chemistry and chemical engineering, biophysics, radiobiology, medical and biological terms, metallurgy, metallography, uranium geology, thorium crystallography, peaceful and military uses of the atom, general terms, and abbreviations.

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Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

The 1958

TENTATIVE program of the Nuclear Engineering and Science Conference of the 1958 Nuclear Congress to be held at the International Amphitheatre, Chicago, Ill., March 17–21, was released recently. This Congress, the fourth of such meetings, is sponsored by the American Nuclear Society and more than 30 national engineering and scientific societies, of which The American Society of Mechanical Engineers is one. The Congress is co-ordinated by Engineers Joint Council.

Preprints of papers listed in this program are available and may be obtained by ordering them by number from the Congress Manager, American Institute of Chemical Engineers, 25 West 45th Street, New York 36, N. Y. To facilitate ordering, a check list will be found elsewhere in this issue.

Additional papers are presently being reviewed by sponsoring societies and when approved will be listed in the final program, which will be available at Congress or AIChE March 17. Preprints of these papers will be on sale at the Amphitheatre. All papers sell for 50 cents each.

TENTATIVE PROGRAM

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71 **Tracer Studies of Fungicidal Action,** by *R. W. Greenlee, R. S. Davidson, H. T. Kemp,* and *M. M. Baldwin*

70 **Radioactive Tracers in Extreme Pressure Lubrication,** by *E. H. Loeser, R. C. Wiquist,* and *S. B. Twiss*

75 **Location of Leaks With Radioisotopes in Multiwalled Tanks,** by *W. F. Sullivan*

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18 **Effects of Pile-Irradiation on U_3Si,** by *M. L. Bleiberg* and *L. J. Jones*

23 **Radiolytic and Pyrolytic Decomposition of Organic Reactor Coolants,** by *D. R. de Halas*

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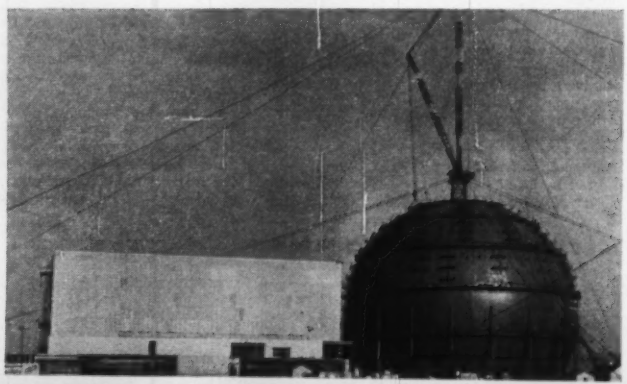
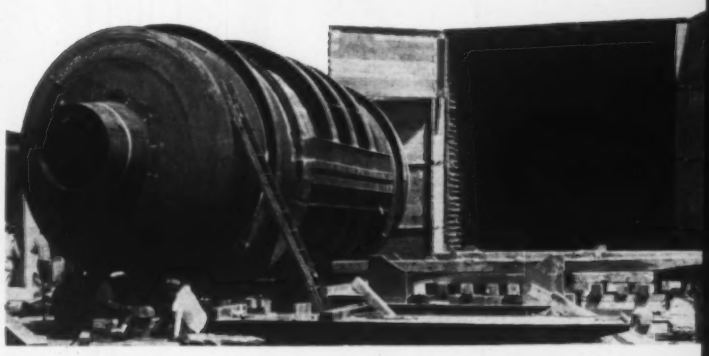
The huge steel sphere and the turbine building for Commonwealth Edison Company's Dresden Nuclear Power Station are nearing completion. Located on the Illinois waterway, 50 miles southwest of Chicago, the 180,000-kw station will have the largest nuclear power reactor under construction in the country. It is scheduled for operation in 1960. Dresden is being built by General Electric Company for a contract price of $45 million.





This massive (40-ft-long, 12½-ft-diam) test chamber shown entering the heat-treating furnace of O. G. Kelley and Company, Boston, Mass., will be part of the testing equipment installed at the CANEL Project (Connecticut Aircraft Nuclear Engine Laboratory) in Middletown, Conn. The vessel will use "T-1," a high yield strength alloy steel produced by Lukens Steel Company, to gain important savings in fabrication and transportation costs. Its job: To permit tests on experimental nuclear aircraft components.

Nuclear Congress Tentative Program Released

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This 100-ton pressure vessel for the prototype nuclear propulsion plant (A1W) of the nation's first atomic-powered surface ship is shown prior to shipment to the Naval Reactors Facility at Arco, Idaho, from the Foster Wheeler plant, Mountaintop, Pa. The vessel was built for use by the Bettis atomic power division of Westinghouse Electric Corporation which has a prime contract with the Atomic Energy Commission to design and develop the nuclear propulsion plant for the ship. The vessel flange has a 137-in. OD. The shell is 105 in. in diam while the reactor vessel is more than 19 ft long.

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Session 37
Chemical Processing, Part 2

8 **The Nitrate Complexes of Tetravalent Plutonium,** by *J. A. Brothers, R. G. Hart,* and *W. G. Mathers*

7 **The Homogeneous Reactor Test Chemical Processing Plant,** by *W. D. Burch*

22 **General Economics of Chemical Reprocessing Using Solvent Extraction Processing** by *F. L. Culler, Jr.*

25 **Effect of Geometrical Shape on the Continuous Dissolution of Aluminum in Mercury—Catalyzed Nitric Acid,** by *A. F. Boeglin* and *J. A. Buckham*

66 **Reprocessing Costs for Fuel From a Single-Region Aqueous Homogeneous Reactor,** by *A. C. Jealous* and *R. J. Klotzbach*

122 **Thorex Short-Cooled Processing,** by *A. B. Meservey*

139 **Reprocessing Uranium-Zirconium Alloy Reactor-Fuel Elements,** by *C. B. Leak, R. B. Lemon,* and *F. K. Wrigley*

ASME to Participate in 1958 American Power Conference

Economic comparisons of the use of various fuels in the near future will be considered at one of the more than 30 sessions comprising the program of the twentieth anniversary meeting of the American Power Conference to be held at the Hotel Sherman, Chicago, Ill., March 26–28.

Discussions at the fuels session will deal with the economics of transporting energy, fuel availability and future power demand, the outlook for high-energy fuels, and the energy aspects of underground gasification processes.

In addition, four sessions will be devoted to various aspects of nuclear energy power applications.

The American Power Conference is sponsored by Illinois Institute of Technology, in co-operation with 14 other colleges and universities and nine professional societies, including The American Society of Mechanical Engineers.

Other subjects to be covered at one or more sessions will include: high-voltage transmission, which will be discussed by a group of foreign scientists; operation of a commercial supercritical-pressure steam-electric generating station; generation, transmission, and utilization of electrical energy; use of pumped storage for hydro-electric stations; steam and gas turbines; industrial power plants; steam generators; and heating and air-conditioning.

Sessions of most interest to mechanical engineers have been selected from the tentative program, and are as follows:

▶ WEDNESDAY, MARCH 26

Registration 9:00 a.m.

Opening Meeting 10:00 a.m.

Public Affairs—A New Dimension for Management, by *F. R. Barnett,* The Richardson Foundation, Inc., New York, N. Y.

The Road Ahead, by *C. L. Wilson,* dean, University of Missouri School of Mines and Metallurgy, Rolla, Mo.

Joint APC-ASME Luncheon 12:15 p.m.

Chairman: *J. N. Landis,* ASME President

Co-Chairman: *E. P. Berg,* chairman, Chicago Section, ASME

Speaker: *J. W. McAfee,* president, Union Electric Company of Missouri, St. Louis, Mo.

Steam Turbines (Sponsored by Power Division of ASME) 2:00 p.m.

Chairman: *W. E. Hopkins,* chairman, Power Division, ASME; and Stone and Webster Engineering Corp., Boston, Mass.

Co-Chairman: *R. C. Porter,* University of Michigan, Ann Arbor, Mich.

Steam Turbines for Nuclear Power Plants, by *J. A. Carlson,* Westinghouse Elec. Corp., Philadelphia, Pa.

High-Temperature Steam-Turbine Design Improvements From Operating Experience, by *E. P. Hansen, A. C. Holmes,* and *J. J. Fleischmann,* Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Turbine Generators for the '60's, by *C. E. Kilbourne* and *C. W. Elston,* Gen. Elec. Co., Schenectady, N. Y.

Water Technology 2:00 p.m.

Panel: Deaeration

Chairman: *S. F. Whirl,* Duquesne Light Co., Pittsburgh, Pa.

Co-Chairman: *T. J. Hodan,* Manager, Water-Conditioning Section, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Deaerators—Manufacturers' Viewpoint. *R. M. Lemen,* The Permutit Co., New York, N. Y.

Condenser Hotwells—Manufacturers' Viewpoint. *R. A. Wilson,* Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Deaeration—Boiler Manufacturers' Viewpoint. *H. A. Grabowski,* Combustion Engineering Co., New York, N. Y.

Deaerators—Operator's Viewpoint. *J. R. Bryan,* Union Electric Co., St. Louis, Mo.

Condenser Hotwells—Operator's Viewpoint. *A. M. Guy,* Southern Indiana Gas and Elec. Co., Evansville, Ind.

Deaeration—Design Engineer's Viewpoint. *W. R. Steur,* Sargent & Lundy, Engineers, Chicago, Ill.

Heating, Ventilation, and Air Conditioning 2:00 p.m.

(Sponsored by the Heating and Air-Conditioning Division, Chicago Section, ASME)

Chairman: *E. P. Berg,* chairman, chicago Section, ASME

Co-Chairman: *H. J. Holloman,* Ragnar Benson, Inc., Engineers and Builders, Chicago, Ill.

Ventilation of Research Nuclear Reactors, by *John Dolio,* Shaw, Metz and Dolio, Architects and Engineers, Chicago, Ill.

The Multistage Heat Pump and Its Applications, by *R. G. Werden,* York Corp., Chicago, Ill.

Central-Station Ventilation, by *R. W. Patterson,* Sargent and Lundy, Engineers, Chicago, Ill.

Off-Peak Electric Panel Heating Using the Heat-Storage Principle, by *R. C. Geyer,* Commonwealth Edison Co., Chicago, Ill.

Evening Forum 7:30 p.m.

A progress report on nuclear developments in the electric-power industry will be held in the Grand Ballroom. Executives of a number of electric-utility companies will describe the current status of the various nuclear reactor projects in which their companies are participating, and discuss their plans for future research and development.

▶ THURSDAY, MARCH 27

Central Stations—I 9:00 a.m.

Co-Chairman: *H. L. Solberg,* head, School of Mechanical Engineering, Purdue University, Lafayette, Ind.

Operating Experience With the First Commercial Supercritical-Pressure Steam-Electric Generating Unit at the Philo Plant, by *T. T. Frankenberg, A. G. Lloyd,* and *E. B. Morris,* American Gas and Elec. Service Corp., New York, N. Y.

Operating Experience With the First Commercial Universal-Pressure Steam Generator at Philo, by *J. D. Andrews, Jr., P. H. Koch,* and *E. A. Pirsh,* The Babcock & Wilcox Co., New York, N. Y.

Operating Experience With the First Commercial Supercritical-Pressure Steam Turbine Built for the Philo Plant, by *R. Sheppard,* Gen. Elec. Co., Schenectady, N. Y.

Fuels (Sponsored by the Fuels Division of ASME) 9:00 a.m.

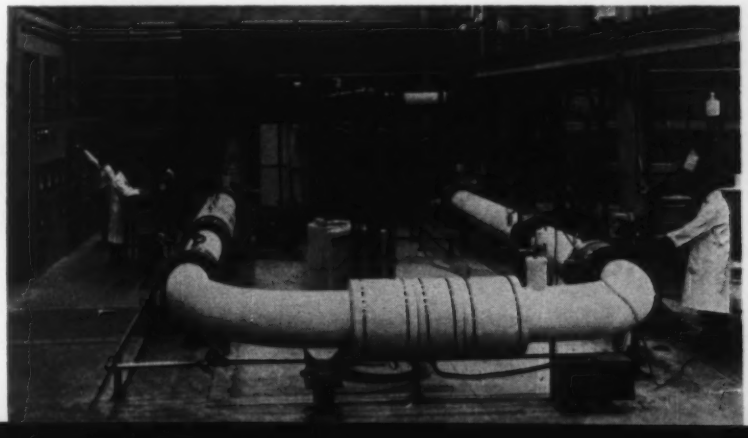
Chairman: *Vaughn Mansfield,* chief engineer, Peabody Coal Co., St. Louis, Mo.

Energy Aspects of Underground Gasification Processes, by *C. D. Pears,* Southern Research Institute, Birmingham, Ala.; *John Capp,* U. S. Bureau of Mines, Gorgas, Ala.; and *M. H. Fies,* Alabama Power Co., Birmingham, Ala.

Economic Trends Affecting Transportation of Energy, by *S. B. Smith,* Ebasco Services, Inc., New York, N. Y.

Fuel Availability and Future Power Demand, by *H. W. Nelson,* Battelle Memorial Inst., Columbus, Ohio

Future Outlook for High Energy Liquid Fuels, by



This "test loop" will circulate a water suspension of thorium oxide, one of the important constituents of the fuel of an advanced type of nuclear reactor. The loop operates at the same pressure and temperature planned for the 150,000-kw atomic-electric generating station now being developed by Westinghouse Electric Corporation and Pennsylvania Power and Light Company, of Allentown, Pa.

C. C. Miesse and *Paul Lieberman*, Armour Res. Foundation, Chicago, Il

Hydroelectric Power—1 **9:00 a.m.**

Symposium: Pumped Storage

Pumped Storage Economics, by *G. R. Rich*, Charles T. Main, Inc., Boston, Mass.

Planning for Pumped Storage, by *E. S. Loane*, Gen. Pub. Util. Corp., Reading, Pa.

Application of Pumped Storage Hydro to Mid-western Terrain, by *G. J. Vencill*, Union Elec. Co., St. Louis, Mo.

Operating Experiences With Large Pumps at Grand Coulee Dam, by *G. R. Barker*, Columbia Basin Project, U. S. Bu. Reclamation, Coulee Dam, Wash.

Central Stations—2 **2:00 p.m.**

Chairman: *Johan A. Carlson*, supervisory engineer, Large Turbine Engineering Department, Westinghouse Elec. Corp., Philadelphia, Pa.

Co-Chairman: *G. F. Markley*, chairman, Power Section, Chicago Section ASME; The Babcock & Wilcox Co., Chicago, Ill.

How to Reduce the Hazard of Inoperative Check Valves, by *L. H. Carr*, Edward Valves Inc., East Chicago, Ind.

The Turbofurnace for Multifuel Firing, by *C. F. Hawley*, Riley Stoker Corp., Worcester, Mass.

From Boiler Boil-Out to Operating Date, by *J. A. Donald, N. A. Miller*, and *C. D. Blanke*, Sargent & Lundy, Chicago, Ill.

Vulnerability of a Central Station Power Plant to Attack by a Nuclear Weapon, by *D. B. Singer*, Armour Res. Foundation, Chicago, Ill.

Water Technology—2
—Ion Exchange **2:00 p.m.**

Chairman: *J. F. Wilkes*, director, Res. and Dev., Dearborn Chem. Co., Chicago, Ill.

Co-Chairman: *L. F. Wirth, Jr.*, manager, Ion Exchange Division, Nat'l. Aluminate Corp., Chicago, Ill.

High-Temperature (475 F) Cation Exchanger Data, by *C. F. Paulson*, Westinghouse Elec. Corp., Pittsburgh, Pa.; and *C. E. Johnson*, Nat'l. Aluminate Corp., Chicago, Ill.

Effect of Dissolved Oxygen on Some Performance Characteristics of Weak and Strong Base Anion Exchangers, by *I. B. Abrams, B. N. Dickinsen*, and *M. R. Roberts*, Chem. Process Co., Redwood City, Calif.

Comparison of Mixed-Bed and Four-Bed Demineralizers, by *F. B. Wink*, Niagara Mohawk Power Corp., Buffalo, N. Y.; and *Durando Miller*, Permutit Co., New York, N. Y.

Demineralizer Treating Hot Lime Zeolite Effluent, by *A. K. Sukumar*, Ford Motor Co., Dearborn, Mich.; and *S. B. Applebaum*, Cochrane Corp., Philadelphia, Pa.

Hydroelectric Power—2 **2:00 p.m.**

Hells Canyon in Retrospect, by *T. E. Roach*, Idaho Power Co., Boise, Idaho.

Engineering Plan and Design for Effective Water Utilization at Brownlee, Oxbow, and Hells Canyon, by *R. E. Gale*, Idaho Power Co., Boise, Idaho.

Construction Progress at Brownlee and Oxbow.

All-Engineers Dinner **6:45 p.m.**

▶ FRIDAY, MARCH 28

Gas Turbines **9:00 a.m.**

A Gas Turbine in the Industrial Steam-Power Cycle, by *J. E. Parker*, Union Carbide Chem. Co., Texas City, Texas

How to Integrate Gas Turbines With Other Generation in an Economical Utility-Generating System, by *W. D. Marsh*, Gen. Elec. Co., Schenectady, N. Y.

Gas Turbines as an Economic Generating Source, by *W. H. Ferguson*, Westinghouse Elec. Corp., East Pittsburgh, Pa.; and *R. E. Strong*, Westinghouse Elec. Corp., South Philadelphia, Pa.

Water Technology—3
—Nuclear Power **9:00 a.m.**

Chairman: *M. D. Baker*, chairman, ASME Joint Research Committee on Boiler Feedwater Studies; chief chemist, West Penn Power Co., Springdale, Pa.

Co-Chairman: *Selden Adkins*, manager, Consulting Service, Nat'l. Aluminate Corp., Chicago, Ill.

Effect of Local Boiling on Corrosion and Deposition on Reactor Heat-Transfer Surfaces, by *R. T. Esper* and *W. E. Hopkins, Jr.*, Westinghouse Elec. Corp., Pittsburgh, Pa.; and *C. Jacklin* and *J. H. Phillips*, Nat'l. Aluminate Corp., Chicago, Ill.

High-Flow Rate Demineralization for Boiling Water Reactors, by *H. W. Fraser*, Infilco, Inc., Tucson, Ariz.; *A. B. Sisson*, Commonwealth Edison Co., Chicago, Ill.; and *R. C. Reid*, Gen. Elec. Co., San Jose, Calif.

Nuclear Energy—1 **10:30 a.m.**

Co-Chairman: *F. W. McCloska*, partner, Sargent & Lundy, Engineers, Chicago, Ill.

Nuclear-Fuel Cycle, by *F. L. Malay* and *D. A. Campbell*, Westinghouse Elec. Corp., East Pittsburgh, Pa.

Problems of Reactor Containment, by *F. B. Porzell*, Armour Res. Foundation, Chicago, Ill.

Nuclear Energy—2 **2:00 p.m.**

Chairman: *R. D. Maxson*, senior vice-president, Commonwealth Edison Co., Chicago, Ill.

Co-Chairman: *Darwin Krucoff*, supervisor, reactor and nuclear systems, physics research, Armour Res. Foundation, Chicago, Ill.

Present Status of the Sodium-Graphite and Organic-Moderated Reactor Concepts for Power Generation, by *Sidney Siegel*, North American Aviation, Inc., Canoga Park, Calif.

A Comparison of Three Nuclear Power-Plant Concepts for Power Generation in the United States, by *K. P. Cohen* and *E. L. Zabroski*, Gen. Elec. Co., San Jose, Calif

Nuclear Power—Where Are We Headed in Costs?, by *L. F. C. Reichle*, Ebasco Services, Inc., New York, N. Y.

Industrial Plants **2:00 p.m.**

Chairman: *M. B. Golber*, head power plant engineer, Armour & Co., Chicago, Ill.

Design of Small Industrial Power Plants to Secure Maximum Net Earnings, by *A. A. Cummins*, Cummins & Barnard, Inc., Engineers, Ann Arbor, Mich.

New Ideas for Industrial Boiler Plant Coal Handling, by *A. J. Stock*, Stock Equipment Co., Cleveland, Ohio

Short-Cut Methods of Quickly Evaluating Alternate Steam and Power Supplies for Industrial Plants, by *W. B. Wilson* and *D. L. E. Jacobs*, Gen. Elec. Co., Schenectady, N. Y.

Water Technology—4
—Analytical and Control **2:00 p.m.**

Chairman: *R. F. Andres*, chairman, Power Stations, Chemistry Subcommittee, Edison Elec. Inst., and chief chemical engineer, Dayton Power and Light Co., Dayton, Ohio

Co-Chairman: *W. R. Homan*, chief chemist, Commonwealth Edison Co., Chicago, Ill.

Continuous Recording Sodium Flame Photometer for Extremely Pure Waters or Steam, by *William Nacoustky* and *W. A. Crandall*, Consolidated Edison Co., New York, N. Y.

$36 Million Technical Information Center Proposed

WESTERN Reserve University's conference on February 4 for the creation of a national center for the co-ordination of scientific and technical information ended on a positive note. A recommendation for a "crash" study program of the technical and other problems involved in the establishment of such a center was formally adopted by 150 U. S. scientists.

The Council on Documentation Research, on which ASME has representation, acting on the recommendation of the WRU conference, will ask the National Academy of Sciences to sponsor the study so that the recommendations will have the national recognition necessary to win the approval and support of industry, government, academic institutions, and the foundations. A report of the Cleveland meeting will be sent to Washington with the request.

Charles I. Campbell, associate for information services at the Rockefeller Institute for Medical Research, brought the resolution to the floor.

Scientists at the conference were in general agreement as to the need for urgent action. Dr. C. D. Gull, of the National Academy of Sciences, who was in attendance at the meeting explained the function of the Academy and observed that the overtures of the Council on Documentation Research would be favorably received. Ben H. Weil of Esso Research and Engineering Company in Linden, N. J., said "a 'crash' program is needed in order to complete the study and decide on the best program for the solution of the information dilemma."

Officials of Western Reserve University's School of Library Science and Center for Documentation and Communication Research estimated, before the conference, the National Information Center would cost $36 million over a ten-year period.

Prior to the adoption of the formal recommendation that the National Academy of Sciences be presented a summary of the WRU conference, the assembled scientists engaged in a free discussion.

Robert J. Kyle of Georgia Institute of Technology recommended a "powerful survey on the needs of the future." He suggested that a "modest committee be appointed to persuade the National Science Foundation to call a meeting" of a committee to study the problems put forth at the WRU conference. Such a committee would not have "an ax to grind."

W. T. Knox, Esso Research and Engineering, said: "Our problem at this point is having available the current abstracting and indexing services on a current basis. They must be up to date."

The possibility that a national Center might be profitable financially was suggested by Charles Bernier of *Chemical Abstracts*. He thought that a National Center would be called on to answer more questions than are now estimated. To meet the challenge, Mr. Bernier recommended that we "do it the American way, organize a corporation. There ought to be room for a profit."

ASME to Make Available Translation of Russian Scientific Literature

THE American Society of Mechanical Engineers has announced that it has undertaken a project for translation of "Prikladnaya Matematika i Mekhanika" (PMM), the Russian Journal of Applied Mathematics and Mechanics, under a $35,000 grant from the National Science Foundation. The ASME Applied Mechanics Division selected this bimonthly journal at its meeting on June 13, 1957, as the most valuable of the Russian publications in the field of mechanical engineering. The Board on Technology approved the suggestion and arranged to secure the grant from NSF. Reportedly, publication will begin about April, 1958.

The announcement noted that the Society had undertaken the task of translation "in an attempt to correct the present situation in which the Russians are familiar with the content of most, if not all, of our technical publications, while only a few of theirs are translated for use by the English-speaking world."

Arrangements have been made with Russian scientists to secure proof sheets of the Russian journal in advance of final printing, to permit speedier translation.

The magazine contains the latest theoretical and practical advances made by Russian scientists in mathematics, fluid dynamics, and solid-state physics. Copies will be sold, on a subscription basis, to any interested persons or groups at an annual rate of $35 for the six issues. ASME members are entitled to a 20 per cent discount. Subscriptions may be ordered from the Order Department, The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y.

This is by no means the first Russian periodical to be made available in English. Consultants Bureau, 227 West 17th Street, New York 11, N. Y., has offered a limited selection as long ago as seven years and now publishes more than 20 periodicals, mainly in the field of chemistry and physics. Other titles include biology and medicine, atomic energy, colloids, crystallography, automation, ceramics, and metallurgy. For further details consult their Catalog No. 3.

Pergamon Institute, Pergamon Press, Inc., 122 East 55th Street, New York 22, N. Y., distributor, publishes more than 16 translated periodicals in the radio, electrical, geophysics, atomic energy, and other highly specialized fields of science and engineering. Pergamon Institute has contracted with the Society for distribution of PMM.

Subscriptions to these periodicals range from $20 to $200 a year, depending on the number of pages. Both afore-mentioned publishers also offer translated pamphlets at modest prices as well as translation service.

Applied Mechanics Reviews, published by ASME for the past ten years, has kept a close watch on Russian technical publications as the following list indicates:

Soviet Publications Reviewed in *Applied Mechanics Reviews*

Akademiya Nauk Armyanskoi SSSR, Dokladi
Akademiya Nauk Armyanskoi SSR Izvestiya, Fiziko-Matematiki, Estestvennye Tekhnicheskie Nauki
Akademiya Nauk Ukrains'koi Radyans'koi Socialistichnoi Respubliki, Kiev, Dopovidi
Akademia Nauk Ukrainskoi SSR Institut Matematiki, Ukrainskii Matematicheskii Zhurnal, Kiev
Akademiia Nauk SSSR, Trudi Instituta Mashinovedemiia, Seminara po Teorii Mashin i Mekhanizmov
Akusticheski Zhurnal, Moscow
Avtomatika i Telemekhanika
Dokladi Akademii Nauk SSSR, Novaya Seriya
Gidrotekhnicheskoe Stroitel'stvo
Gidrotekhnika i Melioratsiia, Moscow
Inzhenernii Sbornik Akademii Nauk SSSR
Izvestiya Akademii Nauk Kazakhstoi SSR, Matematicheskh i Mekhanika
Izvestiya Akademii Nauk SSSR, Otdelenie Tekhnicheskikh Nauk
Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya
Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya
Izvestiya Akademii Nauk SSSR, Seriya Geograficheskaya
Izvestiya Akademii Nauk SSSR, Seriya Matematicheskh
Izvestiya Kazanskogo Filiala Akademii Nauk SSSR, Seriya Fiziko-Matematicheskh i teknicheskh Nauk
Journal of Applied Chemistry USSR (Consultants' Bureau Translation)
Prikladnaya Matematika i Mekhanika
Progress of Mathematical Sciences, Moscow
Progress in Physical Sciences, Moscow
Referativnii Zhurnal Matematika, Moscow
Referativnii Zhurnal Mekhanika, Moscow
Soobshcheniya Akademii Nauk Gruzinskoi SSR
Soviet Journal of Atomic Energy (Consultants' Bureau Translation)
Soviet Physics (JETP)
Stanki i Instrument
Tekhnika Vozdushnogo Flota
Teplo energetika, Moscow
Trudi Energeticheskogo Instituta Akademii Nauk Azerbeidahan SSR
Trudi Fiziologichesko i Institut Akademiya Nauk SSSR, Komissiya po Fiziologicheskoi Akustike
Trudi Moskovskogo, Matematicheskogo Obschchestvo, Moscow
Trudi Seminara po Teorii Maschin i Mekhanizmov
Uchenye Zapiski Karelo-Finskogo Universiteta
Uchenye Zapiski Moskovskogo Gosudarstvennogo Universiteta
Uspekhi Fizicheskikh Nauk
Uspekhi Matematicheskikh Nauk, Novaya Seriya
Vestnik Mashinostroeniya, Moscow (USSR Ministerstvo tiazheloi Promyshlennosti)
Vestnik Moskovskogo Universiteta, Seriya Fiziko-Matematichikh i Estestvennikh Nauk
Zbirnik Prac Institutu Matematiki Akademiya Nauk Ukrainskoi RSR
Zhurnal eksperimental noi i teoreticheskoi Fiziki
Zhurnal tekhnicheskoi fiziki

Library of Congress

While it may seem that Sputnik triggered a spurt of Russian technical literature in the United States, that is not quite the case. The Library of Congress has for the past several years issued monthly catalogs of literature accessions from the Russian and East European areas. *The Monthly List of Russian Accessions* ($12 a year) and *The East European Accessions List* ($10 a year) are sold by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

These lists contain titles of publications received by the Library of Congress and group of co-operating libraries. The title of each monograph and periodical is given in the original language and in English translation. The tables of contents of important periodicals are given in English translation. There is also included in each list a subject guide to the monographs and the periodical articles.

Annual author indexes to the Russian Monographs and annual lists of Russian and East European periodicals are available. The monographs are available from the Library of Congress and the co-operating libraries by interlibrary loan under the regular interlibrary loan regulations.

AAS Meets

SEEN AT THE AAS MEETING

People and events at the American Astronautical Society's fourth annual meeting: 1 H. E. Weimiller, of Republic Aviation, and chairman of the New York Section of the society, who was host at the Honors Night banquet at Midston House. 2 A. N. Stanton, of Varo Manufacturing Company, who accepted a Fellow Award on behalf of Wernher von Braun in Dr. von Braun's absence. 3 Dr. Dael Wolfle, of the American Association for the Advancement of Science, with Ross Fleisig, of Sperry Gyroscope Company, president of the AAS. Dr. Wolfle announced the affiliation of the AAS to the AAAS. 4 Scene during the presentation of a paper at one of the technical sessions. 5 The registration desk in the lobby of the Engineering Societies Building, 29 West 39th Street, New York, N. Y. 6 *Left to right* are: Dr. G. R. Arthur, of RCA, vice-president of the society; N. V. Petersen, of Lockheed; Col. P. A. Campbell, of the Office of Scientific Research, USAF-ARDC, recipient of one of the Fellow Awards; Saunders Kramer, a member of the society; and Ross Fleisig, president. Because of the launching of the Russian satellites, late in 1957, and the imminent launching of our own "Explorer" from Cape Canaveral, the society found itself in the spotlight, its membership growing at a phenomenal rate.

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The fourth annual meeting of the American Astronautical Society took place in New York, N. Y., Jan. 29-31, 1958. The young and growing society brought together its scientists, engineers, and medical men for a series of technical sessions held in auditoriums in the Engineering Societies Building on West 39th Street. At a banquet, held in Midston House, the society did honor to four outstanding men in the missile field, one of them Wernher von Braun.

Starting with what is now its New York Section, the AAS was incorporated in 1954. It now has sections in Boston, Baltimore, Los Angeles, San Francisco, and Washington. Its aims are to encourage research in the field of astronautics, to provide scholarships for worthy students when possible, and to propagate knowledge through its official journal, the *Journal of Astronautics*, and through technical conferences such as the New York meeting. The society believes that manned flight into planetary space is a logical progression from today's high-altitude research planes and large single and double-stage rocket missiles.

The AAS, which has its offices at 516 Fifth Avenue, New York, N. Y., has seen its membership double during the past year, and will probably see it double again during 1958. Credit an assist to Sputnik.

Officials installed for 1958 are headed by Ross Fleisig, president, who is an engineer in missile guidance for the Sperry Gyroscope Company.

At the banquet, the famous Dr. von Braun could not be on hand. His Jupiter rocket stood on the pad at Cape Canaveral, prepared to make history, and he had pressing business at an information center in Washington. A. N. Stanton of Varo Manufacturing Company and the society's technical committee, accepted the award on Dr. von Braun's behalf.

Guest speaker at the banquet was Welcome W. Bender, vice-president and direc-

as America's Satellite Goes Into Orbit

American Astronautical Society meeting brings together scientists, engineers, and medicos. Overflow crowds hear reports on space vehicles and man's space environment.

tor of the Research Institute for Advanced Study, The Martin Company, Baltimore, Md. Mr. Bender spoke on "Science and Research in the Field of Astronautics," calling for increased funds to promote further advances.

Technical Program

The six technical sessions heard papers on space-vehicle design, guidance and control techniques, man's environment in space, space-vehicle communications, astronautics research, and space exploration. The most heavily attended sessions were those on space-vehicle design, and especially man's environment in space.

It was brought out that there are three unknowns in present planning for space travel. They are: The reaction of space environment on a human being (partly a psychological problem); meteoric impact (micrometeorites may damage the surface of space vehicles); weightlessness (an animal can be used to test this). Opinion is that it won't be serious. Drugs may play a part in enabling man to function in space, countering psychological depression and sickness due to weightlessness. A paper entitled "Returning Alive From Space," tackled the immediate problem: We must get a man out there and get him back. Engineers are beginning to implement the advance work of the scientists.

Medicine in Space Travel

The Air Force has undertaken research into the medical aspects of space travel. At the banquet, the Melbourne W. Boynton Award in space medicine went to Major David G. Simons, USAF, who is chief of Space Biology, Aero Medical Field Laboratory, Hollomon Air Force Base, N. Mex. The presentation was made by Major General Otis O. Benson, Jr., USAF (MC), Commandant, School of Aviation Medicine, Randolph Field, Texas.

Here are problems the medicos—and engineers—face in equipping men for outer space: Carbon-dioxide conversion; treatment of bodily wastes; recovery of usable water from contained air, and other sources; removal of pollutants from contained air; purification or disposal of various liquid wastes.

Alfred M. Mayo, Douglas Aircraft Company scientist, delivered a paper in which he reported that the design of a space ship will have to take account of meteor showers, space debris, abnormal temperatures, and ionization by cosmic or solar particles. The design will have to include automatic control of air composition and pressures within a crew's quarters, including regeneration and storage of vital gases. And there will have to be a retropropulsion system to facilitate landing, take-off, and maneuvering in the vacuum of space.

It seems only yesterday that wrap-around windshields were the talk of the country.

Scientist in a Changing Economy and Man and His Environment...

...Subjects of AAAS Section M—Engineering Sessions

"Moving Frontiers of Science: Concepts That Mold Our Work," is the title adopted by the American Association for the Advancement of Science to spotlight the special sessions of general interest presented by the Association at its annual meetings. In keeping with this theme, at the Association's 124th annual meeting in Indianapolis, Ind., late in 1957, Section M—Engineering presented a program of research trends and findings whose many ramifications are of interest to all branches of science.

The factors affecting the scientist and scientific research in a changing economy were delineated by a group of authorities. Speakers considered such aspects of the situation as scientific advance as a factor in economic change, new and changing activities of scientists, and the support of scientific research. The many new dimensions in scientific training and the research center's importance as a potential training area as well as for pure scientific research were noted. Comparative salary and income levels among scientists also entered the discussions.

Concurrently, a session was held which dealt with man in his environment. While results of attempts to modify weather by cloud seeding have been encouraging, steps toward weather control are hampered by the lack of basic knowledge of weather phenomena—What causes ice ages? How does precipitation form in clouds? How does the air move in clouds?—all unanswered questions.

Improved methods of meteorological measurements in relation to weather are needed. Better instruments are needed to measure characteristics of clouds and precipitation, humidity, and the constituents of air pollution. Other measurements required include those of the geophysical properties such as sound waves, electromagnetic waves, electricity and magnetism, gravity, and reactive characteristics—moisture and heat transfer.

The capabilities of the electronic computers now available to meteorologists improve the organization of weather data for short and long-range predictions. Information for use by the weather forecaster eventually will have to include data from weather-modification activities. In the future, both weather-prediction and weather-control problems will be merged into one over-all problem.

Indoor environment, the controllable segment of man's surroundings, was considered in terms of comfortable-temperature data, industrial noise, light and glare, and air contaminants.

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

ASME Technology Executives Conference Seeks to

IN TWO DAYS of intensive sessions at Arden House, Harriman Campus of Columbia University, Harriman, N. Y., Jan. 5–7, 1958, Professional Division representatives, Research, Publications, and Meetings Committee members; several ASME vice-presidents, and members of Council and of the Board on Technology—considered the broad policy and experience spectrum covered by activities under the direction of the Board on Technology.

The purpose of these Conferences is the discussion of problems relating to the Board on Technology and the Professional Divisions, Meetings, Publications, and Research Committees and to provide guidance to the committee members for their use during the year in carrying out the policies and aims of the Society.

Sessions began in earnest on Monday morning, following an informal meeting on Sunday night. ASME President James N. Landis stated in his welcoming remarks that the work of the conference "will help the technologists of the United States maintain the prestige of our country in the cold-war era in which we live. The technological side of ASME life which you are fostering here certainly constitutes the hard central core of the reason for the existence of ASME."

Outlining some of the cardinal objectives of his term as President, as he saw them at that point, he stressed assistance to the ASME Secretariat, encouraging Student Members to become active Associate Members, helping the Old Guard become more effectively organized to help the Society better, and the stimulation of the nomination of qualified members to Fellow grade.

He read and directed attention to the article by Walter Barrett, president of AIEE, on the proposal to facilitate unification of the engineering profession, which was published in MECHANICAL ENGINEERING, February, 1958.

In a brief outline of the purposes of the conference and the functions of the Board on Technology, Thomas F. Perkinson, TEC general chairman and 1958 chairman of the ASME Board on Technology, likened the Divisions to "product divisions in industry, for getting out the product—mechanical engineering—to the trade."

Research

Everett M. Barber, chairman, Research Executive Committee, stated that the function of ASME research was not to undertake advanced scientific research or proprietary development, but "to make a critical evaluation and development of an area of technology for the development of a solid mastery of that area." Such research should fill voids and, equally important, it should resolve conflicts.

Function. The function of a research committee is to outline areas of research, to highlight specific needs, and to stimulate the advancement and application of specific projects. It also should encourage the development of personnel technically competent to cope with the technology. Development of an adequate and manageable program, and a clear statement of scope are important steps. For example, the definition of scope of the Joint Research Committee on Boiler Feedwater Studies was recommended as a model.

The Research Committee on Fluid Meters was cited as an excellent example of a comprehensively organized committee, operating within a specific area of the field of fluid flow. As many as 200 people at a time have served on the main committee and its 15 active subcommittees. It has continuously reviewed the field for overlaps and voids, and has consistently developed the technology out to a further depth or sophistication.

A committee can evaluate better than an individual because of the greater breadth and depth of experience possessed by a group, and it can also stimulate individuals to think.

History. Reviewing the history of ASME research, Mr. Barber stated that a Main Research Committee had been established in 1909 to foster special research committees in various fields. A 1926–1927 summary showed that, in this peak period of research activity, the Council appropriated $14,000 for use by 24 research committees with 290 members who supervised projects employing 70 full and part-time researchers. A decline during the 1940's reached a low ebb in the 1950's. In 1952, the Council "reaffirmed its conviction that a strong and vital approach to research was essential to the Society."

Arden House Meeting considers Board on Technology problems

Improve Services to Members

When the reorganized structure, consisting of a Research Executive Committee, a Research Planning Committee, and a newly created staff Research Manager began to function in 1953, some committees had had the same chairman for 20 years, and several had held no meeting in ten years. A 1956 review of operations under the new structure indicated that some progress had been made, but the rate was still not good enough to meet Council objectives.

Participation. Mr. Barber reminded those present that it was difficult to obtain widespread participation in the Society's research activities where certain Professional Divisions have failed to appoint a representative to the Research Planning Committee. He urged those Divisions which had not already done so to appoint such representatives as soon as possible. The person chosen should not only have a background and interest in research but have the ability to serve as an effective liaison between the Research and Professional Division activities. Research activities need to be better known, and it is hoped that research committees will submit expanded reports to Division conferences beyond those included in the first Annual Report of ASME Research.

Comments. In commenting on Mr. Barber's presentation, Glenn Warren stated that he thought that ASME research was in "far better shape than it has ever been" and that he couldn't compliment those responsible too highly. He differed with the admonition that research committees should not be program-making agencies. The most successful committees in the past have done some program making, he said. Research should not be a competitive activity between Divisions. Before a specific Research Committee is set up, the Divisions should determine where research or related activity has been taking place. This would not only determine where research would be of value to more than one Division, but would help compensate for the fact that one third of the Divisions have no committees reviewing the research in their individual fields.

This would have bearing on E. W. Jacobson's remark that the dividing line between Research and Division operations exists in various degrees. Lubrication was a good example of a near correspondence of fields.

The route to and from Sections via the vice-presidents was recommended by W. H. Byrne, vice-president, ASME Region II, as another means of letting the members know what the Society is doing in research, and offers a possible alternate route for initiating projects.

American Rocket Society

Charles H. King and J. J. Harford of the American Rocket Society were present to explain the relationship of that society to ASME. Mr. King, Mem. ASME and chairman, ASME-ARS Joint Committee, said co-operation between the two is close in the Connecticut Valley, as in several other areas. Unfortunately, it was noted, the ARS Annual Meeting may have to be separated from the ASME Annual Meeting because of its growth in size and the shortage of hotel space.

From the days when ARS was "not so respectable" and ASME, by "lending its dignity," was a major help in "getting them into hotels," and providing "authors' breakfasts for hungry authors," the ARS has grown to 31 sections. The ARS has a joint conference with the ASME Aviation Division this month, will co-sponsor a National Telemetering Conference with AIEE and others, and is the only American society with membership in the International Astronautical Federation.

Publications

Kerr Atkinson, chairman, Publications Committee, introduced the subject of publications by reading the pertinent section from the ASME Annual Report, which was published as Part 2 of the January, 1958, issue of MECHANICAL ENGINEERING. He supplemented this with a financial statement.

Pamphlets. Recognition of the "pamphlet," which is the preferred title for preprints, as a permanent form of publication, he stated, would help solve many of the problems of the Publications Committee. Every effort is being made to improve the editorial handling and appearance of pamphlets to achieve such recognition. The growing volume of technical papers, which totaled 859 for 1957, has made it increasingly difficult to republish these in the various journals of

TEC answers the questions

Listed left to right

1 Practical approaches to Division problems, derived from the experience of particular Divisions, were presented by Mead Bradner, A. T. Wuska, A. F. Rhodes, F. L. Murphy, P. R. Sidler, R. Tom Sawyer, and L. S. Dennegar. 2 ASME Publications policies and procedures were reviewed by B. G. A. Skrotzki, Kerr Atkinson, and H. N. Blackmon. 3 The ASME Annual Meeting was evaluated and discussed by R. G. Folsom, Glenn Warren, L. N. Rowley, and K. L. Selby.

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the Society. All accepted papers, in pamphlet form, are included in the *Engineering Index* and the ASME Indexes, and are bound in yearly volumes by the Engineering Societies Library. Even papers which are not published in pamphlet form are permanently bound for reference in the Library. Publication in the journals should not be considered necessary for the bulk of papers and should be confined to those of broadest interest having permanent reference value.

Reviewer's Report. Glenn R. Fryling introduced a revised version of the ASME Reviewer's Report. This is designed so that the reviewer can: (*a*) Evaluate the merits of the paper, and (*b*) fit this evaluation into recommendations conforming with ASME practices of technical-paper presentation and publication. The report is intended to: (*a*) Educate the reviewer, in the sense of providing information on the review process, and (*b*) to convey information from the reviewer to the Papers Review Committee and the ASME Editorial Department.

To accomplish this, the reviewer's report is phrased in questions whose answers are not obvious unless the reviewer has read and studied the paper. Reviewers are also encouraged to write out their informal reactions to technical papers.

B. G. A. Skrotzki demonstrated the changes in pamphlets since 1955. Then, the pamphlet was a corner-stapled assembly of single pages with a cover sheet. The abstract was on the back of the cover, illustrations were confusingly grouped in one position and captions in another at the end of the paper. The pamphlet has now emerged in a saddle-stitched two-column format with illustrations interspersed near references in the text.

Deadlines. H. N. Blackmon pointed out that enforcement of a realistic set of deadlines for papers is as important to ASME as a timetable is to a railroad. The current set of deadlines represents a joint effort of the Meetings, Publications, Professional Divisions, and Research Committees. The schedule takes into consideration the two main types of papers normally presented at Society meetings—the permanent interest or reference type, and the current interest or general type paper. The new procedure offers a specific deadline date for each of these types. These are: the first of the third month before the meeting, the first of the second month before the meeting, and a final deadline of four weeks before the meeting.

The permanent interest or reference type, if it is recommended for ultimate publication in the Transactions of ASME, must be received at Headquarters complete with recommendation by the first of the third month before the meeting. If this condition is met, typeset pamphlet copies will be assured for distribution before, during, and after the meeting.

Papers of current or general interest, if received at Headquarters by the first of the second month before the meeting, complete with recommendation, will be processed as multilithographed pamphlet copies for distribution before, during, and after the meeting.

Recommended papers received at Headquarters four weeks before the meeting will also be prepared as multilithographed pamphlet copies, but their completion will not be guaranteed for distribution before and during the meeting. They will, however, be available from Headquarters for ten months after the meeting and will be listed along with the others in the Availability List that appears in MECHANICAL ENGINEERING with the account of the meeting.

The budget simply will not permit rush multilithing of "4-weekers." This is unfortunate, since advance publication is essential if there is to be discussion. Divisions should realize that these are year-round deadlines and not applicable to Annual Meeting papers alone.

In spite of the increase in the number of papers from 553 in 1953 to 859 in 1957, the number of papers prepared in time for meetings has increased from 78 to 82 per cent.

Professional Divisions

Divisions Manual. The new Professional Divisions Manual, MS-11, issued in January, 1958, by the Board on Technology was introduced by Paul R. Sidler, chairman, Professional Divisions Committee, and TEC co-chairman. The manual is a practical working guide for nearly any problem which a Division may encounter, something which has been needed badly with the increasing complexity of the Society and its activities. This was well demonstrated when T. A. Marshall, Jr., senior assistant secretary, ASME, produced a pocket-size 12-page booklet that sufficed as a 1927 Divisions Manual.

Division Scope. Revised statements on the scope of the various professional Divisions are planned for publication, and should be an aid in formulation of Division policy as well as clarification for everyone concerned.

Division Service. Most Division problems revolve around finding individuals who are competent and willing to undertake committee work. Finding these

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people requires constant search through Division newsletters, correspondence, and personal contacts.

Newsletters. Newsletters are now issued by a number of Divisions, and funds are available for one issue a year. Applications for funds should indicate if additional issues are planned at Division expense to facilitate the scheduling of mailing which is handled by the ASME staff. To be successful, newsletters should be undertaken with a significant purpose in mind and should not merely duplicate conference announcements issued by the meetings staff.

Progress Reports. Another type of Division publication is the annual progress report, best typified by the Railroad Division's. F. L. Murphy, one of the members of the committee which prepares that report, stated that most of the detailed work was handled by two members. The report is the result of a canvass of committee members and equipment manufacturers. The two principal compilers work all through the year, noting information in the railway publications, and preparing an approximately final entry on each item as it is discovered. Photographs are requested at the time. Cross checking has revealed that little information is missed when this procedure is used.

How One Division Functions. A. F. Rhodes of the Petroleum Division stated that that Division is oriented toward the annual Petroleum Conferences which require the work of 70 to 85 members throughout the year. These conferences draw 500 to 800 top petroleum mechanical engineers, although these are not necessarily members of ASME. The concentration of members interested in that Division in the Southwest has led to unique Division-Section relationships.

Division-Section Relations. The North Texas Section formed a special petroleum-luncheon group for highly technical sessions by the best men in the field. These draw more than the evening, general Section meetings. The South Texas Section followed suit with a similar program which draws 90 to 130, again more than the evening Section meetings.

The Petroleum Division also has a Sections liaison committee composed of representatives from every Section with petroleum interest. The Houston petroleum group was responsible for 100 new applications for membership last year, for a total Section membership of 750.

Meetings

The Meetings Committee is an operational committee whose objective is an ideal technical meeting. Glenn Fryling, chairman, Meetings Committee, stated that there are seven criteria for an ideal meeting: (*a*) High quality, carefully selected, and conscientiously reviewed technical papers, (*b*) a convenient meeting location, (*c*) an unconflicting meeting time, (*d*) publicity far enough in advance, (*e*) advance publication of papers, (*f*) adequate meeting and committee space, (*g*) a proper program balance of technical papers, social events, inspection trips, and lectures.

Meeting Objectives. The Meetings Committee is endeavoring to work out with EJC the establishment of a master list of meetings to avoid conflicts. Size is another problem. As one example of a very large meeting, the American Chemical Society presented 1509 papers in 211 sessions by 5330 authors in a dozen New York hotels and exhibit buildings, at its most recent meeting. How big should the ASME Annual Meeting get? This question is answered in many different ways. The Meetings Committee can schedule as large a meeting as wanted. What common interests do all mechanical engineers share? What per cent of their time at meetings do engineers want to spend outside of their Division or specialty? How much time for informal activities?

W. B. Wilkins discussed the new exhibit policy adopted by the Council on June 8, 1957, which is included as appendix 6 in the MS-11 Manual.

Technical Paper Sales. With respect to the distribution of technical papers, several experiments are being made. At one session a copy was sold to each person present by having the student aides distribute them. Another experiment is planned where each person will receive a set of the papers to be presented at that session, with the choice of returning or buying them as he leaves the room.

Program Making. Mr. Wilkins suggested that all program-making agencies ought to appoint their program chairmen at least one year in advance, thus insuring a certain amount of continuity in the agency's program planning. H. E. Walchli commented that in the Nuclear Division the papers-review chairman becomes program chairman the following year so that he is thoroughly familiar with the previous year's papers. Some idea of the scope of their review problem is given by the fact that the Division reviewed 200 papers last year.

Annual Meeting

Council Member L. N. Rowley was chairman of a discussion and evaluation of the Annual Meeting. Physical limits are being reached—330,000 sq ft of floor space now being used for technical ses-

sions—and a major enlargement will have to be made. The increasing emphasis on Division conferences also calls for reconsideration of the type of Division participation in the Annual Meeting.

K. L. Selby of the Meetings Committee presented a statistical study which showed that the number of papers presented reached an all-time high in 1957, but the Annual Meeting represents a decreasing percentage compared with Division conferences. The number of papers presented at ASME conferences including the Nuclear Congress is now about 450.

Glenn Warren spoke on the "exploding tendency" in number of papers and sessions at the Annual Meeting, which he was "willing to let evolve over the years into something better." He said program-making methods, however, should be improved.

He added that communication was becoming a major problem, and that it was worth while for the Research Committee to undertake a fundamental study of new means of conveying, storing, and classifying technical literature. This is particularly important to ASME since he believes "mechanical engineering is more widespread in its influence on technology than any other field of engineering."

R. G. Folsom stated that there were two classes of papers—those that had been thoroughly worked up and integrated into a program session, and others that just grew. There was also a two-part division on content between technical-data and descriptive types of papers.

It should be borne in mind, he stated, that acceptance and publication of a paper constitutes a "pat on the back" and is influential in considerations for promotion, particularly in academic circles.

1958 Annual Meeting Plans. D. B. MacDougall, Meetings and Divisions manager, reviewed the 1958 Annual Meeting program as far as it had been developed, noting the need for clear understanding of the function of each of the Divisions in a joint session or program. Indications show that the meeting will have more than 110 technical sessions. He emphasized in regard to papers review that the primary sponsor is responsible for the review of a paper.

The type of paper and program for the Annual Meeting were the topics of considerable discussion. Mr. Rowley believes "that the Annual Meeting should be for "cross-fertilization of ideas between Divisions" plus broad-outlook reviews of progress in the field. Newer fields should be particularly stressed since these reach a peak of general interest, and then become primarily of interest to the specialist.

Conference Planning

Mr. Marshall pointed out that joint conferences are growing, that each operates with slightly different rules, and that timing and location in regard to closely related societies are important. Clearcut separation of responsibility between the Division and Section, and precise distribution of expense are vital. The Division should not delegate technical programming to the Sections. Mr. MacDougall emphasized that a Division conference should be a "package program," unified in content.

Reporter System. A letter from M. L. Cooke, Fellow ASME, was read, suggesting that the reporter system, used in several sessions of the last two Annual Meetings, be used for presenting technical papers at all sessions. Mr. Sidler was asked to comment from experience with such conferences in Europe. The language difficulties, he stated, are an important reason for its use there, since the system permits all papers to be reduced to a common language. The content of the papers must be unified if the system is to be successful. There should be ample time in advance for the reporter to do a good review and condensation; and much depends on finding persons with broad technical background.

R. Tom Sawyer commented that it takes about two years to get papers in, have them correlated, digested, and otherwise prepared. Other discussers emphasized that the system takes away the important prerogative of the author which permits him to present his own paper.

Use of the reporter system is suited to certain types of conferences with a homogeneous audience of specialists, a homogeneous group of papers, skilled reporters, and excellent prepared discussion to promote oral discussion.

The system does emphasize the importance of having the author present a synopsis of his own paper at the customary type of session. In spite of all requests to the contrary, many authors still read their papers in full. To obtain the author's co-operation requires an early enough reminder to permit him to prepare a briefer presentation. One method of getting more authors to do this is to request that they supply a speaking outline with the paper. ASME Secretary O. B. Schier, II, suggested that a good method was to "put topic sentences on 3 × 5-in. cards and then throw away the paper."

Evaluating Papers. Mr. Rhodes told about a Univac evaluation of the 1957 Petroleum Conference papers. The technical information contributed was considered, more than rating papers good or poor; was the subject fully covered, is additional information needed, and what did the discussion add to the topic?

Round-Table Discussion

A final discussion on Tuesday afternoon was open to any topic related to the conference. The importance of making the Junior feel welcome, introduced earlier by Mr. Folsom, was re-emphasized. The Chicago Section uses a prize award for papers to bring him into the program. A. T. Wuska had stated earlier that the Birmingham Section puts Associate Members on committees. The Section also has a newsletter. Welcoming newcomers is used to advantage in other organizations and might be considered for ASME.

E. W. Allardt, vice-president, ASME Region V, spoke on the importance of letting Sections know what is going on, and what is wanted. The Sections need action if they are to flourish, he remarked.

The question of making newcomers welcome was also related to membership applications since transfers of Students to Associate are a principal source of growth. A section is geographically "on the spot" and can make the personal contacts so important in building membership. Attendance cards can be used as a source of potential members, and the Division is the proper agent for using them, since those qualified for membership will be best recognized there. C. A. Jurgensen saw nothing wrong with using the direct approach where management in particular suggests that people join, or at least inquire about, membership.

Technical papers were the subject of additional comments. Mr. Folsom suggested that listing the session topics for the Annual Meeting in MECHANICAL ENGINEERING, as soon as these had taken shape, could be of help in stimulating additional papers. Glenn Warren emphasized the responsibility for getting papers that point to new areas of technical knowledge.

ASME-AIEE Railroad Conference Scheduled April 9-10, Hotel Statler, Cleveland

THE 1958 Railroad Conference will be held in the Hotel Statler, Cleveland, Ohio, on April 9-10, 1958. Jointly sponsored by the Railroad Division of The American Society of Mechanical Engineers and the Land Transportation Committee of the American Institute of Electrical Engineers with the co-operation of the Cleveland Section ASME, 14 technical papers will be presented and promise to be of much interest to those engaged in this field.

Two special luncheons and a banquet have been arranged with prominent railroad authorities as guest speakers.

The tentative program is as follows:

▶ WEDNESDAY, APRIL 9

Registration 8:00 a.m.–5:00 p.m.

Session 1 9:00 a.m.–12:00 noon

Methods of Improving Utilization of Motive Power, by *G. T. Bevan*, Gen. Elec. Co. (AIEE Paper No. 58—501)

Dollar Damage Done to Diesel Locomotives by Dirt, by *M. B. Adams*, Atcheson, Topeka and Santa Fe RR (AIEE Paper No. 58—500)

An Evaluation of the Effect of Dirt on Diesel-Electric Locomotives, by *J. W. Horine*, Pennsylvania RR (AIEE Paper No. 58—504)

Social Hour 12:00–12:30 p.m.

Luncheon 12:30 p.m.–2:00 p.m.

Session 2 2:00 p.m.–5:00 p.m.

Field Experience With Electrostatic Precipitation on Diesel Locomotive Engine Air Intake, by *P. Kangas, W. C. Kern*, Baltimore and Ohio RR, and *E. L. Richardson*, Westinghouse Elec. Corp. (AIEE Paper No. 58—504)

Railway-Traction Equipment Ventilating Systems, by *B. A. Widell*, Gen. Elec. Co. (AIEE Paper No. 58—507)

Improving Rail Adhesion for Diesel Locomotives, by *P. Gorin*, Southern Pacific RR

Banquet 7:00 p.m.

▶ THURSDAY, APRIL 10

Registration 8:00 a.m.–5:00 p.m.

Session 3 9:00 a.m.–12:00 noon

An Analog Computer Study of a Torsional Vibration Problem, by *S. W. McElhenny*, Gen. Elec. Co., and *R. T. Gray* (AIEE Paper No. 58—502)

Wheel-Slip Protection, by *C. M. Hines*, Westinghouse Air Brake (AIEE Paper No. 58—503)

Available and Potential Developments in Design for Standard A.A.R. Solid Bearing Assemblies, by *M. A. Hanson*, Magnus Metal Corp. (ASME Paper No. 58—RR-3)

The Hydrocushion Car, by *W. K. MacCurdy* and *R. M. Hermes*, Stanford Res. Inst. (ASME Paper No. 58—RR-2)

Social Hour 12:00 noon–12:30 p.m.

Luncheon 12:30 p.m.–2:00 p.m.

[1] Paper not available—see box on this page.

Session 4 2:00 p.m.–5:00 p.m.

Vibration and Shock in Freight Cars as Causes of Lading Damage, by *J. C. Settles*, Buckeye Steel Castings Co. (ASME Paper No. 58—RR-4)

Railroading in Canada,[1] by *R. E. Swanson*, Department of Railways, Canada

Aluminum in Rolling Stock, Impact Tests at Collision Speeds, by *R. A. Campbell, J. G. Sutherland, J. F. Whiting*, Aluminum Company of Canada, and *R. A. Kemp* (ASME Paper No. 58—RR-1)

Availability of Papers

ONLY *numbered* ASME papers in this program are available in separate copy form until Feb. 1, 1959. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents to members of ASME, 50 cents to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference. AIEE papers may be purchased from the Institute, above address, for 40 cents each.

ASME Production Engineering Conference to Cover Production, Inventory Control Techniques

"NEW Techniques for Production and Inventory Control" will be the theme of the Production Engineering Conference to be held at the Hotel Bancroft, April 10, at Worcester, Mass. The Conference is sponsored by the Production Engineering Division of The American Society of Mechanical Engineers in co-operation with the Worcester Section.

During the afternoon and evening sessions, six technical papers will be presented. Norman A. Blodgett, Worcester patent attorney, will be the coffee speaker at the evening dinner and will discuss peculiar patents. Arthur B. Bronwell, president of Worcester Polytechnic Institute, will be toastmaster. Albert A. E. Bock and Donald Taylor are co-chairmen of the conference.

Other committee members include: Robert S. Hahn, program and technical events; Roger M. Scott, finance; Cyrus S. Yingst, registration; J. Adams Holbrook, hospitality; Edward W. Randall, hotel; and Roger N. Perry, Jr., publicity.

▶ APRIL 10

Registration 12:30–7:30 p.m.

Session 1 2:00 p.m.

Chairman: *Robert S. Hahn*, chief research engineer, The Heald Machine Co., Worcester, Mass.
Vice-Chairman: *Roland T. Nelson*, production manager, Machine Division, Norton Co., Worcester, Mass.

Orders for Technical Papers

COPIES of papers listed in this program are available in separate copy form until Feb. 1, 1959. Copies may be obtained from the ASME Order Department, 29 W. 39th Street, New York 18, N. Y. Prices are 25 cents each to members of ASME, 50 cents each to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned.

Automatology Applied to Data Processing, by *A. F. Maynard*, Light Military Electronics Equipment Department, General Electric Co. (Paper No. 58—PROD-1)

A System for Computer Control of Production and Inventory, by *J. E. Haynes*, IBM Corp. (Paper No. 58—PROD-5)

Cut Inventories—Cut Stock-Outs, by *N. V. Reinfeld*, National Institute of Management (Paper No. 58—PROD-4)

Examples of Reorder Control System, by *R. G. Brown*, Arthur D. Little, Inc. (Paper No. 58—PROD-2)

Social Hour 5:30 p.m.

Banquet 6:30 p.m.

Toastmaster: *Arthur B. Bronwell*, president, Worcester Polytechnic Institute
Coffee Speaker: *Norman A. Blodgett*, patent attorney
Subject: **Peculiar Patents**

Session 2 7:30 p.m.

Chairman: *Charles E. Crede*, vice-president, ASME Region I, vice-president, Barry Controls, Inc., Watertown, Mass.

Vice-Chairman: *Raymond H. Tolman*, manager of industrial engineering, Bay State Abrasive Co., Westboro, Mass.

A Proposed Data-Processing System for Control of a Job-Shop Machine Floor, by *W. R. Elmendorf*, IBM Corp. (Paper No. 58—PROD-3)

The Computer in Job-Shop Production Control, by *W. Bruce Pirnie, Jr.*, Jones and Lamson Machine Co., Springfield, Vt. (Paper No. 58—PROD-6)

First Annual ASME Maintenance and Plant Engineering Conference to Be Held April 14–15

Penn-Sheraton Hotel, Pittsburgh, Pa., headquarters; outstanding program has been set up—events include banquet, luncheon, and plant tour

GREAT interest has been generated in the spring conference being staged in Pittsburgh, Pa., by the Maintenance and Plant Engineering Division of The American Society of Mechanical Engineers. This is the first national conference of the group. Technical sessions will be held morning and afternoon, Monday, April 14, in the Penn-Sheraton Hotel, Pittsburgh, Pa. Tuesday morning will be devoted to a maintenance panel discussion and Tuesday afternoon to a plant tour.

Session 1 will get under way at 9:30 a.m., April 14, and will be preceded by registration beginning at 8:15 a.m.

The banquet, to be held Monday evening, will be addressed by J. N. Landis, ASME President. Guerard Mackey, of the engineering department of E. I. du Pont de Nemours Company, Inc., and chairman of the Executive Committee, Maintenance and Plant Engineering Division, will be banquet chairman. S. Howarth, chairman, ASME Pittsburgh Section, will be chairman of the Monday luncheon. P. M. Matthews, director of manufacturing, Apparatus Products, Westinghouse Electric Corporation, will be the luncheon speaker.

In general the conference papers and discussions will be concerned mainly with engineering maintenance, maintenance organization, maintenance stores, vibration and balancing problems in maintenance, and optical tooling. The agenda of the panel discussion, Tuesday morning, will be based on various timely topics that have been submitted, and J. D. Quinn, chairman of the Program Committee, will preside at the panel discussion. The conference attendants will tour the Homestead Works of U. S. Steel on Tuesday afternoon.

Attendance at the conference is expected to be unusually good. In the past few years interest in the maintenance and plant-engineering fields has grown by leaps and bounds; furthermore, many engineers will be interested in seeing Pittsburgh's civic improvements that are the talk of the world.

Future conferences of the group are planned for Chicago (1959), St. Louis (1960), and annually thereafter in logical geographic areas.

Scope of activity of the Maintenance and Plant Engineering Group is to promote the art and science of mechanical engineering in the fields of maintenance and plant engineering. Specifically, group activities will include: Managerial and control aspects of maintenance, analysis and corrective action on maintenance problems; design as well as modification of equipment and facilities to reduce maintenance costs; designing and construction of additions, or alterations, to buildings, equipment, and facilities; provision and maintenance of utility services; salvage as well as disposal of obsolete and scrap equipment.

Mellon Square opened October, 1955. Into the heart of the Golden Triangle, it has brought the majestic beauty of trees and shrubs, fountains and cascades accented by multicolored lights at night. Under the park, on six levels, 1000 parking spaces were constructed by the Pittsburgh Parking Authority for the convenience of shoppers and visitors to major office buildings nearby. Cost of dual project: $7.8 million. At the *rear left*, faced in aluminum, is the Alcoa Building, a departure from the use of conventional materials for skyscrapers. Building in *upper right* is the Penn-Sheraton Hotel where the ASME Maintenance and Plant Engineering Conference will be held April 14–15.

Attend a 1958 Regional Administrative Committee Meeting

ATTENDANCE at RAC Meetings has proved to be an informative experience for ASME members. To be present as observers provides a special opportunity to learn of the organization and operation of the Society.

A schedule of the 1958 Meetings is listed in the February issue of MECHANICAL ENGINEERING, page 140. Members are urged to attend this activity which is planned for their Region. It is to be noted that those who participate in the capacity of observers do so at their own expense.

ASME COMING EVENTS

March 2–6

ASME Gas Turbine Power Conference and Exhibit, Shoreham Hotel, Washington, D. C.

March 16–22

Nuclear Congress, International Amphitheater, Chicago, Ill. (ASME is cosponsor.)

March 16–20

ASME-ARS Joint Aviation Conference, Hotel Statler-Hilton, Dallas, Texas

March 19–20

ASME-AIEE Engineering Management Conference, Somerset Hotel, Boston, Mass.

March 20–21

ASME Textile Engineering Conference, North Carolina State College, Raleigh, N. C.

March 30–April 1

ASME-FPRS Joint Wood Industries Conference, Syracuse University, Syracuse, N. Y.

April 2–4

ASME Instruments and Regulators Conference, University of Delaware, Newark, Del.

April 9–10

ASME-AIEE Railroad Conference, Hotel Statler, Cleveland, Ohio

April 10

ASME Production Engineering Conference, Hotel Bancroft, Worcester, Mass.

April 14–15

ASME Maintenance and Plant Engineering Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

April 14–17

ASME Design Engineering Conference, International Amphitheater, Chicago, Ill.

April 15–17

ASME-AWS Metals Engineering Joint Conference, Hotel Statler, St. Louis, Mo.

April 22–25

ASME Boiler and Pressure Vessel Committee Out-of-Town Meeting held jointly with the National Board of Boiler and Pressure Vessel Inspectors, Raddison Hotel, St. Paul, Minn.

April 24–25

ASME-SAM Management Conference, Hotel Statler, New York, N. Y.

May 11–15

ASME Oil and Gas Power Conference and Exhibit, Bellevue-Stratford Hotel, Philadelphia, Pa.

June 9–12

ASME Materials Handling Conference, Cleveland Auditorium, Cleveland, Ohio

June 11–14

Third U. S. Congress of Theoretical and Applied Mechanics, Brown University, Providence, R. I. (ASME is cosponsor.)

June 15–19

ASME Semi-Annual Meeting, Hotel Statler, Detroit, Mich.

Aug. 18–21

ASME-AIChE Heat Transfer Conference, Northwestern University, Evanston, Ill.

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

(*For Meetings of Other Societies, see page 145*)

ASME Design Engineering Conference and Show Prepares for Large Audience in Chicago

The third annual Design Engineering Conference and Show will be held April 14 through 17 at the International Amphitheater, Chicago, Ill. All plans for this event reportedly are geared to the accommodation of an attendance of more than 15,000 engineers and executives.

The Conference is sponsored by the Machine Design Division of The American Society of Mechanical Engineers. The technical sessions will be devoted to mechanical, material, power and control, and general engineering subjects. Methods of achieving a better exchange of information among engineers in the "information center of tomorrow" will be a keynote of the topics for discussion. Sessions will commence at 10:00 a.m. on Monday; the starting time will be 9:30 a.m. thereafter.

More than 400 exhibitors will display and demonstrate mechanical components, power-transmission equipment, metallic and nonmetallic parts, processes and finishes, and many other instruments at the Design Engineering Show. The exhibit will be open from Monday through Thursday from 12:00 noon until 5:30 p.m.

J. T. Rettaliata, Mem. ASME, president of Illinois Institute of Technology, will make a major address at the Tuesday luncheon to be held at the Stock Yard Inn. His talk is entitled "Creativeness—Key to Industrial Progress."

Conference and show fee ($5 to ASME members; $10 to nonmembers), includes preprints of all papers, admission to all sessions, admission to show, and a follow-up report of pertinent discussion of all conference papers, plus a transcript of Monday's panel session. The registration fee for the Design Engineering Show only is $2.

The tentative technical program follows:

▶ MONDAY, APRIL 14

Session 1 — **10:00 a.m.**

Putting the Design Into Production

Chairman and Moderator: *George F. Nordenholt*, editor, *Product Engineering*, 1933–1957

Vice-Chairman: *Arthur Socolofsky*, project engineer, Acme Steel Co., Chicago, Ill.

Panel Members

Leo Kevitt, manager, Manufacturing Instrument and Alemite Division, Stewart Warner Corp., Chicago, Ill.

Joseph Manuele, director, Headquarters Quality Control, Westinghouse Electric Corp., Pittsburgh, Pa.

Donald L. Harwood, vice-president, purchases, Fairbanks, Morse and Co., Chicago, Ill.

H. Walter Regensburger, chief engineer, General Engineering Department, Link Belt Co., Chicago, Ill.

▶ TUESDAY, APRIL 15

Session 2 — **9:30 a.m.**

Mechanical Session

Chairman: *Colin Carmichael*, editor, *Machine Design*, Cleveland, Ohio

Vice-Chairman: *J. James Stone, Jr.*, chief, Systems Engineering Division, Battelle Memorial Institute, Columbus, Ohio

Mechanical Memory Devices, by *Arthur Mirel*, General Engineering Laboratory, American Machine and Foundry Co., Greenwich, Conn. (Paper No. 58—MD-1)

Automatic Inspection, by *Dave McConnell*, Autometrology Division, Sheffield Corp., Dayton, Ohio (Paper No. 58—MD-2)

J. T. Rettaliata, president, Illinois Institute of Technology, will give major address at Design Engineering Conference

Session 3 **9:30 a.m.**

Materials Session

Chairman: *Henry R. Clauser*, editor, *Materials in Design Engineering*, New York, N. Y.

Vice-Chairman: *James E. Johnston*, vice-president, Custom Molding Division, Chicago Molded Products Corp., Chicago, Ill.

Shock Resistance of Plastics, by *G. R. Rugger, E. McAbee,* and *M. Chmura*, Plastics Materials Testing and Specification Unit, Picatinny Arsenal, Dover, N. J. (Paper No. 58—MD-3)

Uncommon Engineering Metals, by *J. P. Denny* and *L. F. Kendall, Jr.*, General Engineering Laboratory, General Electric Co., Schenectady, N. Y. (Paper No. 58—MD-4)

Session 4 **9:30 a.m.**

Power and Control Session

Chairman: *Frank J. Oliver*, editor, *Electrical Manufacturing*, New York, N. Y.

Vice-Chairman: *Theodore A. Wetzel*, chief engineer, research and development, Kearney and Trecker Corp., Milwaukee, Wis.

Electrohydraulic Systems on Machine Tools, by *E. J. Rivoire* and *A. A. Dall*, Electric Hydraulic and Gaging Division, Cincinnati Milling Machine Co., Cincinnati, Ohio (Paper No. 58—MD-5)

Electrohydraulic Systems on Aircraft, by *F. L. Moncher*, Aero Hydraulics Division, and *L. D. Taylor*, Research and Development Department, Vickers Inc., Detroit, Mich. (Paper No. 58—MD-6)

Luncheon **12:15 p.m.**

Speaker: *J. T. Rettaliata*, president, Illinois Institute of Technology, Chicago, Ill.

Subject: **Creativeness—Key to Industrial Progress**

▶ WEDNESDAY, APRIL 16

Session 5 **9:30 a.m.**

Mechanical Session

Chairman: *C. T. Blake*, director of engineering, The Warner and Swasey Co., Cleveland, Ohio

Vice-Chairman: *C. A. Nothmann*, manager, department of Mechanical Engineering Research, Armour Research Foundation, Chicago, Ill.

Problems in Designing Automatic Machinery, by *M. J. Fallot*, New Jersey Machine Corp., Hoboken, N. J. (Paper No. 58—MD-7)

Lubricant Considerations in Centralized Systems, by *R. K. Gould* and *R. D. Skoglund*, Texaco Research Center, Beacon, N. Y. (Paper No. 58—MD-8)

Session 6 **9:30 a.m.**

Materials Session

Chairman: *Walter Starkey*, associate professor, Mechanical Engineering Department, Ohio State University, Columbus, Ohio

Vice-Chairman: *Norman E. Bateson*, deputy director of research, Pullman Standard Car Manufacturing Co., Hammond, Ind.

Compatibility of Metals in Bearing Contact, by *C. L. Goodzeit*, General Motors Research Center, Detroit, Mich. (Paper No. 58—MD-9)

High-Strength Structural Sandwich Construction, by *W. E. Dirkes*, Plastic Products Section, Wright Air Development Center, Wright Patterson Field, Ohio (Paper No. 58—MD-10)

Session 7 **9:30 a.m.**

Power and Control Session

Chairman: *E. M. Ramberg*, vice-president, engineering, Titeflex, Inc., Springfield, Mass.

Vice-Chairman: *Sidney Davis*, consulting engineer, East Norwich, L. I., N. Y.

Integrating Mechanical and Electrical Design in Servo Systems, by *W. L. McCann*, Giddings and Lewis Machine Tool Co., Fond-du-Lac, Wis. (Paper No. 58—MD-11)

Solving Mechanical-Electrical Problems in Servo Systems, by *Glenn Ertell*, Specialty Control Department, General Electric Co., Waynesboro, Va. (Paper No. 58—MD-12)

▶ THURSDAY, APRIL 17

Session 8 **9:30 a.m.**

General Engineering Session

Chairman: *William Budington*, associate librarian, John Crerar Library, Chicago, Ill.

Vice-Chairman: *E. H. Cann*, assistant manager, Graphic Reproduction Sales Division, Eastman Kodak Co., Rochester, N. Y.

The Information Center of Tomorrow, by *Allen Kent* and *J. W. Perry*, Center for Documentation and Communication Research, Western Reserve University, Cleveland, Ohio (Paper No. 58—MD-13)

A Central Catalog File Saves Time and Money, by *J. L. Dykes*, Commercial Records Management, Engineering Department, E. I. du Pont de Nemours and Co., Inc., Wilmington, Del. (Paper No. 58—MD-14)

Four ASME Metals Engineering Sessions Featured on AWS Meeting Program

THE conference of the Metals Engineering Division of The American Society of Mechanical Engineers will present four sessions during the 1958 American Welding Society's national spring meeting. The meeting will be held in St. Louis, Mo., at the Hotel Statler, April 14–18.

The AWS program is to be presented in 17 sessions. The ASME papers will discuss strength of welds; mating of structural properties with design; design and material for low-temperature application; and casting weldments.

Included among the AWS sessions will be two each on resistance welding, brazing, and gas-shielded welding. In addition there will be three sessions on steel weldability and research, while single sessions are scheduled for titanium; aluminum and magnesium; uranium, titanium, and high-nickel alloys; submerged-arc welding; application, equipment, and inspection; welding arcs and heat flow; welding structures; and designing for welding.

Two plant tours include the A. O. Smith Corporation plant in Granite City, Ill., April 16, where visitors will see for the first time the mass-production assembly line of the all-welded 1958 Chevrolet automobile body frame. The next day, the tour will cover the Midwest Piping Company, a leading prefabricator of welded power plant piping and pipe fittings.

Other features of the over-all program include the Adams Lecture by Ernest F. Nippes, Rensselaer Polytechnic Institute, on "The Weld Heat-Affected Zone." Bennet Cerf, publisher of Random House, will be the guest speaker at the banquet, April 14. Prof. E. R. Parker, University of California, will deliver the educational lectures on "Engineering Behavior of Welded Structures."

The Welding Show, featuring exhibits and demonstrations of the latest equipment, filler metals, and supplies used in the welding industry, will be housed at Kiel Auditorium from April 15 to 17.

The ASME portion of the program is as follows:

Kiel Auditorium, on Market Street fronting on Memorial Plaza in the heart of St. Louis, Mo., is where the Welding Show will be held, April 15–17, in conjunction with the ASME-AWS Welding Conference

▶ TUESDAY, APRIL 15

Session 4 Strength of Welds

9:30 a.m.

Chairman: *C. E. Bowman*, University of Illinois

Co-Chairman: *E. A. Kerby*, Midwest Piping Co., St. Louis, Mo.

Co-operative Investigation of a New Welding Electrode for Stainless Steels,[1] by *R. D. Wylie*, Boiler Division, Barberton Works, The Babcock and Wilcox Co.

The Welding of Cr-Mo-V Steels for High-Temperature Service,[1] by *R. J. Christoffel, R. M.*

[1] Paper not available—see box on page 145.

Availability of Papers

ONLY *numbered* ASME papers in this program are available in separate copy form until Feb. 1, 1959. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents to members of ASME, 50 cents to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference.

Curran, F. H. Domina, and *C. H. Soldan,* large steam-turbine-generator department, General Electric Co., Schenectady, N. Y.

Welding Qualifications and Component Performance,[1] by *W. L. Fleischmann,* Knolls Atomic Power Laboratory, General Electric Co., Schenectady, N. Y.

Session 7 Mating of Structural Properties With Design 2:00 p.m.

Chairman: *W. E. Cooper,* Knolls Atomic Power Laboratory, General Electric Co., Schenectady, N. Y.

Co-Chairman: *William Burggrave,* Monsanto Chemical Co., St. Louis, Mo.

Design Values for Thermal Stress in Ductile Materials, by *B. F. Langer,* Westinghouse Electric Corp., Pittsburgh, Pa. (Paper No. 58—MET-1)

Design of Thin-Walled Pressure Vessels Based Upon the Plastic Range, by *M. G. Sharma* and *J. Marin,* Pennsylvania State University (Paper No. 58—MET-2)

Ductility and Energy Relation in Charpy Test of Structural Steels,[1] by *J. H. Gross* and *R. D. Stout,* Lehigh University

[1] Paper not available—see box on page 145.

▶ WEDNESDAY, APRIL 16

Session 10 Design and Material for Low-Temperature Application 9:30 a.m.

Chairman: *M. A. Shank,* Massachusetts Institute of Technology

Co-Chairman: *R. Cristian,* Nooter Corp., St. Louis, Mo.

The Effect of Heat Treatment on the Microstructure and Low-Tempering Properties of Pressure-Vessel Steels,[1] by *J. H. Gross, E. H. Koltcamp,* and *R. D. Stout,* Lehigh University

Some Results of Fatigue and Welding Tests of 9 Per Cent Nickel-Steel Plate, by *T. N. Armstrong,* International Nickel Co., New York, N. Y., *J. H. Gross,* Lehigh University, and *R. E. Brien* (Paper No. 58—MET-3)

Pressure Equipment for Low-Temperature Service,[1] by *C. R. Soderberg, Jr.,* The M. W. Kellogg Co., New York, N. Y.

▶ THURSDAY, APRIL 17

Session 16 Casting Weldments 9:30 a.m.

Chairman: *Sidney Low,* Chapman Valve Manufacturing Co., Wilbraham, Mass.

Co-Chairman: *C. Rulfs,* Union Electric Co., St. Louis, Mo.

Casting Weldments in a Petroleum Refinery, by *J. Bland, C. B. Parrish,* and *R. C. Wheeler,* Standard Oil Co. (Paper No. 58—MET-5)

The Welding of Low-Alloy Steel Castings Designed for High-Temperature, High-Pressure Service, by *N. A. Chapin, C. H. Soldan,* and *L. W. Songer,* large steam-turbine-generator department, General Electric Co., Schenectady, N. Y. (Paper No. 58 MET-4)

Welding Cast Components for Nuclear Power Application,[1] by *W. N. Rice,* Electric Steel Foundry Co.

MEETINGS OF OTHER SOCIETIES

March 18–19

Steel Founders' Society of America, annual meeting, Drake Hotel, Chicago, Ill.

March 25–27

The Institution of Mechanical Engineers, Conference on Technology of Engineering Manufacture, London, England

March 25–27

International Electrotechnical Commission, Technical Committee 33 on Power Capacitors, Paris, France

March 26–28

The Society of the Plastics Industry, Inc., annual Pacific Coast Section conference, El Mirador Hotel, Palm Springs, Calif.

March 31–April 1

Fifth annual Industrial Engineering Conference, Purdue University, Lafayette, Ind.

March 31–April 2

First annual Texas Conference on "Utilization of Atomic Energy," Texas A & M College, College Station, Texas

March 31–April 4

American Management Association, Research and Development Division, management methods for professional people, Sheraton-Astor Hotel, New York, N. Y.

(*ASME Coming Events, see page 143*)

Joint ASME, AIEE, IRE Conference on Automatic Techniques to Offer Broad Array of Significant Papers

Meeting slated for Detroit, April 14–16, to emphasize automatic control techniques for raw material processing and manufacturing industries

FINAL details have been made for the technical program of the first Joint Conference on Automatic Techniques to be held at the Hotel Statler in Detroit, Mich., April 14-16. A total of 19 papers will be delivered during the three-day meeting.

The scheduled papers fall into three categories: (1) Automatic control and test techniques for flow process, manufacturing, and utility operations; (2) engineering, design, and business data computation and processing; and (3) utilization of control components.

Based on requests for information received by the three co-operating societies, high attendance is expected.

A partial list of papers to be delivered include the following:

Numerical Control Proves Itself in Production, by *C. M. Rhoades,* Gen. Elec. Co., Schenectady, N. Y.

Semi-Automatic Circuit Component Tester, by *F. C. Brammer,* IBM, Kingston, N. Y.

Advanced Automatic Controls Applied to Metal Rolling and Processing Electrical Drive Systems, by *E. H. Browning,* Westinghouse Elec. Corp., East Pittsburgh, Pa.

Control Systems Design by Logic: Safety Interlocks and Sequential Controls for Chemical Processes, by *J. P. Laird,* E. I. du Pont de Nemours & Co., Wilmington, Del.

Electronic Control of New Tidewater Refinery, by *Neil Blair,* Panellit, Inc., Chicago, Ill.

An Analog Computer as an Active Part of a 200-hp Automobile Dynamometer System, by *G. E. Hindley,* Reliance Elec. & Engineering Co., Cleveland, Ohio

Data Processing and Control for Steel Mills, by *D. E. Cummings,* Beckman Instruments, Inc., Berkeley, Calif.

Process Instrumentation for Measurement and Control of Level, by *George Revesz,* Robertshaw-Fulton Control Co., Philadelphia, Pa.

The Application of Punch Cards to Automatic Weighing of Bulk Materials, by *W. B. Young,* Richardson Scale Co., Clifton, N. J.

Survey of the Application of Automatic Control Devices for Electric Power Generation, by *A. C. Hartranft* and *F. H. Light, Jr.,* Philadelphia Elec. Co., Philadelphia, Pa.

Application of Computers to Automotive Design and System Studies, by *J. T. Olsztyn,* Gen. Motor Corp., Detroit, Mich.

Automatic Engineering Through Computers, by *R. W. Ferguson,* Westinghouse Elec. Corp., East Pittsburgh, Pa.

Automatic Techniques, Using Large Computers & Engineering Computations, by *V. Paschkis,* Columbia University

Automatic Data Collection, Handling, and Computation in Highway Design, by *J. M. Cahn,* Benson-Lehner Corp., Los Angeles, Calif.

Automatic Job Control Data Systems, by *Carl Pilnick,* Consolidated Avionics Corp., Westbury, N. Y.

A Nationwide System for Automatic Processing of Business Data, by *W. F. Gregory* and *W. J. Walsh,* Western Union Telegraph Co., New York, N. Y.

The Impact of Available Numerical Control Components on Machine-Tool Design, *Ralph Schumann* and *Edward Loeffler,* The Warner & Swazey Co., Cleveland, Ohio

Basic Gages and Gaging Considerations for Automatic Machine Control, by *J. W. Hopper,* Pratt & Whitney Machine Tool Co., West Hartford, Conn.

Industrial Servo Valve Applications, by *R. G. Spencer,* Vickers, Inc., Detroit, Mich.

ASME Members: Nominations Are in Order for 1958

THE time is fast approaching when members of the National Nominating Committee will be meeting to select the nominees for office in The American Society of Mechanical Engineers.

This democratic process of Society government can be promulgated only by your active participation in the mechanics. If you have any specific names to submit for nominations, now is the time for you to help fill the slate.

You may make your nomination through your Section representative or directly through Charles A. Davis, Secretary of the 1958 National Nominating Committee Deere & Company, 1325 Third Avenue, Moline, Ill. Your nomination must be on forms which may be obtained from members of the Nominating Committee as well as ASME.

Members are reminded that, in accordance with the Society's Constitution, candidates for office of President, Vice-Presidents, and Directors shall be of the grade of Fellow or Member. Members wishing to speak in support of any proposed nominee have the privilege of appearing before the National Nominating Committee at a meeting to be held during the Semi-Annual Meeting at the Hotel Statler, Detroit, Mich., June 16 and 17, 1958.

You are also reminded that the proposed nominees for officers are to be men who are responsible individually and collectively for the administration of your Society. They are the trustees for the Society, a corporation with more than a million dollars in assets and an annual income of more than $2 million. These officers are to be regarded by the members of the Society and the public as leaders in their profession.

As officers, they are expected to possess those qualities of character, vision, leadership, responsibility, and broad understanding that will justify the faith of the members. As these men must stand before the public, they should preferably possess abilities of dignified public address.

Make your nominations known to your Section representative who, in turn, is a member of the Regional Nominating Subcommittee. The organization of the 1958 National Nominating Committee was published in the August, 1957, issue of MECHANICAL ENGINEERING, pp. 821–822.

ASME Elects Five to Grade of Fellow Member

THE American Society of Mechanical Engineers has honored five of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow, one must be an engineer with acknowledged engineering attainment, have 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and be a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men who were so honored for their outstanding contributions to their profession and to the Society are:

Edward H. Barry

EDWARD H. BARRY, mechanical engineer, Stone and Webster Engineering Corporation, Boston, Mass., has earned acclaim for his work in the field of steam-power engineering. While not primarily noted for his early work, Mr. Barry as a commissioned officer in the U. S. Naval Reserve during World War I and while serving in the Bureau of Ordnance was one of the inventors of the pilot-directing aviation bombsight. In this period also, he did pioneer work in the development and testing of aviation ordnance—machine guns, sights and mounts, the Davis nonrecoil gun for antisubmarine use, and bombing and gunnery training devices. In association with West Virginia Pulp and Paper Company, New York, N. Y., as supervisor of power, he designed several power plants including one for a new board mill and was responsible for power plant improvement, efficient operation, and plant expansion for five pulp and paper mills. During this period he invented and patented improvements to boilers and control devices. For three years, Mr. Barry was with the Riley Stoker Company, Worcester, Mass., as general sales manager. In 1939, he organized a private consulting practice concerned mainly with modernization of industrial steam plants. Later, in 1942, he joined the Stone and Webster Engineering Corporation where he has been responsible for power plant studies, final design, specifications, and purchasing negotiations. He holds many patents and is the author of a large number of articles published in the technical press. At present, he is mechanical engineer member of the Board of Registration of Professional Engineers and Land Surveyors of the Commonwealth of Massachusetts, and has served as its secretary, vice-chairman, and for the year 1957 was its chairman. He is a member of the National Society of Professional Engineers, and the National Council of State Boards of Engineering Examiners. He has served on the council of Engineering Societies of New England, in addition to several committees of the ASME and other professional societies. For three years, he served on the Executive Committee of the ASME Boston Section and is a past-chairman of that section. He is a member of the Newcomen Society and a registered engineer in Massachusetts, New York, Vermont, and Maine.

Myron R. Bowerman

MYRON R. BOWERMAN, director of research, The Alliance Machine Company, Alliance, Ohio, has distinguished himself as an authority in the field of crane construction. Mr. Bowerman joined the company in 1917, and rose to his present position in the engineering department from detailer, to checker, to foreman, and then to assistant to the chief engineer. He has contributed greatly to the development of many types of specialized overhead traveling cranes, such as soaking pit cranes, stripper and extractor cranes, open-hearth charging machine, ladle cranes, and so on. He has begun a new standardization program for crane bridge and trolley travel and hoist drives. Mr. Bowerman's activities have not been confined to industry, and his reputation not restricted to the great steel companies throughout the country, he has also been engaged in the field of education. From 1912 to 1917, he was professor of engineering at the Kansas State College, Manhattan, Kan. Cranes, as well as gearing and calculation of back gearing for lathes, have been among the subjects of articles written by Mr. Bowerman for technical publications. He is a member of the American Welding Society and the Association of Iron and Steel Engineers; also the American Institute of Electrical Engineers and Tau Beta Pi. Served as chairman of the Akron-Canton Section of ASME; member of National Committee on Education and Training for the Industries; National Nominating Committee, 1947. He is licensed in Ohio.

Carey H. Brown

Carey H. Brown, retired manager of engineering and manufacturing services, Kodak Park Works, Eastman Kodak Company, Rochester, N. Y., has been acclaimed for his activities in industry, government, and the community. His affiliation with Kodak began in 1934 as superintendent of engineering and maintenance at Kodak Park. He was chief of engineering services and later plant manager of the Holston Ordnance Works, Tennessee Eastman Corporation, Kingston, Tenn., from 1942 to 1945, when the plant led the world in the production of high explosives in terms of tonnage. He then assumed the position from which he retired in 1954, and was in charge of engineering, construction, maintenance, utilities, and various service divisions. Prior to 1933, he was executive director, Rochester Civic Improvement Association; 1933 to 1934, he was on the technical board of the U. S. Administration of Public Works. He had been a commissioned officer in the Corps of Engineers in the U. S. Army and served with engineer troops in the United States, Mexico, Panama, and France from 1912 to 1919. As assistant engineer commissioner of the District of Columbia from 1919 to 1923, he was engaged in the development and enforcement of the first zoning regulations and in the development of utilities and public buildings of the District, and from 1923 to 1929 served as engineer of the National Capital Park and Planning Commission. He served as a member of the Task Force on Water Resources and Power of the Second Hoover Commission following similar activities on a Task Committee of Engineers Joint Council. He has been president or chairman of many organizations both professional and civic. In 1953, he delivered the Society's Roy V. Wright Lecture entitled "The Engineer and His Community." He has written a number of articles on engineering education and utilization of engineering manpower. He served as chairman on the Engineering Manpower Commission of the EJC and has written papers on the objectives and activities of that group. Colonel Brown is presently a member of the board of directors of ASCE.

Oswald S. Carliss

Oswald S. Carliss, director of engineering, The Yale & Towne Manufacturing Company, Philadelphia, Pa., has been cited for his significant contributions to the engineering profession and for his active participation in community projects. His engineering career began as a co-operative student at Worthington Pump and Machinery Corporation, Harrison, N. J., in 1928. He later went to Stirling Foundry, Stirling, N. J., and in 1933 was assistant to the supervisor of industrial relations at Newark College of Engineering, where he assisted with the general operation of the co-operative plan of college training. In 1934, he joined the H & B American Machine Company, Pawtucket, R. I., as chief engineer in charge of all drafting, design, and development work for a complete line of cotton and cut-rayon processing machinery. As a mechanical designer with the Wood Newspaper and Machine Company, Plainfield, N. J., he was engaged in the design of printing equipment. At the Kron Company, Bridgeport, Conn., in 1937, as chief engineer, he supervised all drafting, design, and development on a line of industrial dial scales. In this connection, he holds patents on many types of weighing and measuring apparatus. The Kron Company was purchased by The Yale and Towne Manufacturing Company in 1944, and Mr. Carliss moved to Philadelphia with that company. Here he worked on the development of a new type dial indicating mechanism, a new type of platform scale, and the redesigning of the hopper-type lever systems which are used largely in the batching industry. He has been in his present position since 1952, and in this capacity he has supervised work on gas and diesel trucks, electric trucks, hand trucks, and electric and hand hoists. He also supervises the company's experimental department. He has presented and had published many papers on materials handling. He is a member of the SAE, The American Society of Naval Engineers, American Materials Handling Society, The Franklin Institute, and Tau Beta Pi. As a member of this Society he has been an active member of the Fluid Power Systems Subcommittee of the Hydraulics Division and in 1957 was its chairman. He holds honorary membership in the British Industrial Truck Association. He is a member of the Industrial Truck Association, served as chairman of the Engineering Committee in 1957, and is again chairman for 1958. In 1956, he represented the ITA in Paris at the Fédération Européenne de la Manutention, and in Vienna in 1957. He is a registered professional engineer in the State of Pennsylvania.

Richard G. Folsom

Richard Gilman Folsom, president, Rensselaer Polytechnic Institute, Troy, N. Y., has earned distinction in engineering education, in research, and as a consultant in engineering. When he was enrolled at the California Institute of Technology as an undergraduate student, and in 1928 received a BS degree in mechanical engineering, his educational pattern was made. He continued his studies at Cal Tech for his graduate degrees, MS conferred in 1929 and PhD, in 1932; and at the same time beginning his career in education—serving as a teaching fellow at the Institute. He joined the faculty of engineering at the Univeristy of California at Berkeley in 1933 and rose through the academic ranks to chairman of the Division of Mechanical Engineering in 1949. He remained in this position until 1953 when he went to the University of Michigan as director of the Engineering Research Institute and professor of mechanical engineering. It was this position which he relinquished to assume his present office. Rigorous training in fundamentals and a creative approach to their application have distinguished his teaching in the areas of thermodynamics, fluid mechanics, and experimental engineering. Dr. Folsom's research efforts have been directed toward numerous investigations in the field of fluid mechanics including centrifugal and deep-well pump studies, flowmeter research, wave and wave action studies, and experimental and theoretical studies of rarefied gas flow dynamics. His consulting services have been received by such firms as General Electric, Detroit Controls, Aerojet General, and the U. S. Navy. As an administrator, his activities are deserving of equal note. While director of the Engineering Research Institute at Michigan, he was responsible for an extremely large dollar volume of research (approximately $12.5 million in 1957). Author or co-author of over 30 articles and papers, his work has been published in the journals of the ASME and other professional societies, as well as in the technical press.

His participation in ASME activities includes membership on the Professional Divisions Executive Committee and the Educational Advisory Committee. He is research secretary for the Hydraulic Division, and Hydraulic Division representative on the Research Planning Committee. The Research Committee on Fluid Meters and the Power Test Codes Committee No. 8—Centrifugal Pumps also include him as a member. Other societies of which he is a member include ASEE, ARS, and AIChE; he is on the ECPD Education and Accreditation Committee; he also is an associate fellow of the Institute of the Aeronautical Sciences, and a member of Sigma Xi and Tau Beta Pi. He is a consulting editor for the McGraw-Hill Series in Mechanical Engineering.

Conducted for the National Junior Committee
N. J. VIEHMANN

JUNIOR FORUM

Professional Development and Engineering Registration

By E. T. Donovan[2]

LAST year marked the 50th anniversary of the enactment of the first engineering registration law, Wyoming's law of 1907. Almost from the beginning, engineering registration laws carried a connotation of a requirement of professional development beyond a formal engineering education as one of the criteria for registration. This connotation is certainly obvious in the requirements, even in the early laws, that college graduation alone is not a sufficient qualification for registration, but that, in addition, the candidate must present a record of at least four years of experience satisfactory to the board. There is certainly more than an implication that, during the four years during which experience is being acquired, the young engineer will grow and develop professionally to a status of competence meriting the recognition of licensure.

Model Law for Engineering Registration

As early as 1909, the American Society of Civil Engineers became interested in the subject of registration and debated the question in their meetings and in their proceedings. By 1911, a committee of ASCE had drafted the first Model Law for engineering registration, and although the committee report was not endorsed by the society, that Model Law, together with later revisions of it, became the basis of most of the actual state laws which have been enacted subsequently. The latest Model Law, that of 1946, still contains a requirement of "at least 4 years of experience in engineering work of a character satisfactory to the board, and indicating that the applicant be competent to practice engineering." The last words of this sentence are significant in emphasizing that development of the applicant be carried to a minimum level of attainment, that level which makes him competent to carry on engineering work. The 1946 law has been endorsed by The American Society of Mechanical Engineers, as were some of the previous versions, as well as by a dozen other engineering societies.

Growth of Engineering Registration

The growth of engineering registration may be looked upon as phenomenal or disappointing, depending upon the standard used in judging the growth. Engineering registration dates back only 50 years, and this only in the sparsely settled state of Wyoming. Registration laws were not passed in the more populous states until 1915 and later. The latest registration law in the country was not enacted until 1950. With this law, every state and political subdivision of the United States provides for the registration of engineers. In spite of this relatively recent enactment of registration laws, the roster of licensed engineers has grown by leaps and bounds. In 1907, or prior to 1907, the registration was, of course, zero. By 1930, the total number registered in this country was only 20,000; by 1940, 60,000; by 1950, 150,000; and by 1957 something in excess of 210,000, or approximately one third of the professional engineers in the United States. The growth figures seem encouraging; but the fact that unregistered engineers outnumber registered engineers, two to one, should give us cause to wonder and question whether engineering registration has been entirely successful.

Comparison is sometimes made with the medical profession or with the legal profession where all practitioners are registered. Perhaps the principal explanation of the difference between these professions and that of engineering is that in these professions registration is a prerequisite of practice, whereas in engineering it is a prerequisite only to private practice and most engineers are not in private practice.

Registration as Step to Unity

If the junior engineer were to ask me, "Why should I become registered when two out of three engineers have not found it necessary to do so?" I would like to answer his question on the purely unselfish basis of his contribution to the improvement of the engineering profession, by joining the ranks of those who are legally recognized as engineers. Also, engineering registration would probably contribute to the unity of the profession. The growth of registration may evertually end the use of the name "engineer," by that extremely large group of persons for whom the name seems to have a fatal fascination, and who would like to apply it to themselves, no matter what their work may be.

Perhaps, the more effective argument for registration of the junior beginner is a more selfish one: Registration will provide certification of his professional qualifications and provide for him professional identification and recognition. Registration does not make a better engineer. All registration does is place the stamp of accomplishment on him. The professional development that has taken place has occurred prior to registration.

If such development has taken place previous to being licensed, it can be expected that development will be continued subsequent to that event. Professional development should be reflected in income. A bulletin of the Schenectady General Electric Engineers Association recently published results tending to prove such a relationship. The results of a questionnaire returned by 2346 engineers were given in some detail and were summarized as follows: "The man with the license is the beneficiary of probably $2000 to $2500 a year more in salary in the age level above 40 years. Below 40, the advantage is reduced to $500 to $1000 per year. At all levels a financial advantage exists for the licensed engineer." The report goes on to question whether the salary differential is the result of the license, and suggests the possibility that the same personal ingredients which activate them to work for a license also result in the acceptance of greater responsibility in their work. This same bulletin also indicates that in General Electric, by middle age, approximately 50 per cent of the engineers are registered.

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[2] Acting dean of technology, University of New Hampshire, Durham, N. H. Mem. ASME.

Young Engineers and Registration

It would seem to me that much of the burden of spreading the gospel of registration must fall on the junior engineers. We older men have become accustomed to the age in which the men with licenses were either nonexistent or in the small minority. The junior engineers are entering their careers to find registrants approaching equality in numbers with nonregistrants. I am sure that they will find in the near future that registration will become a mark of the successful engineer and that preparation for registration will become an important factor in professional development.

Registration Ever-Increasing Importance

With changes which are taking place in engineering education, registration is becoming more important than ever. For better or worse, engineering education is placing more emphasis on basic sciences and the fundamental engineering sciences and less on engineering applications, assuming that the application of science to engineering can be acquired by the young engineer in the early years after graduation. But the young engineer cannot acquire competence by any process of osmosis. He must study and work, and apply himself more than he ever did in college. He must develop to qualify for registration. He cannot afford a postcollege slump.

ASME Members Asked to Assist in . . .

. . . Guidance—The Engineer's Responsibility

ENGINEERS have an obligation to the profession and a continuing responsibility to interest qualified young people in our secondary schools in entering the engineering profession.

Engineers generally are aware of the importance that engineers play in our economy and of the increasing role that they will fill in the future. In spite of fluctuations in the business cycle, the continuation of our technological progress will require a steady and increasing flow of highly qualified engineering graduates into the profession. Our economy and our national defense need engineers and will continue to need them over the years in increasing numbers.

The Guidance Committee of the Engineers' Council for Professional Development has been engaged in guidance work to interest those secondary school students possessing the necessary aptitudes to embark on engineering careers. Under the sponsorship of the national committee, the country has been divided into eight regions, each with a regional chairman. The regional chairmen have organized state committees to implement the guidance work at the "grass roots" level. It is here that the effective guidance work is accomplished. To date, committees in 48 states and the District of Columbia have been organized. These state guidance committees work directly with the high schools, counseling students to study mathematics and the sciences and urging those who show the necessary aptitudes to consider a career in engineering.

The state guidance committees carry out their objectives through a wide variety of projects and programs, through talks and panel presentations before student groups and assemblies and before teachers, vocational counselors, and parents; through inspection trips and the showing of appropriate technical films; through the promotion of engineering clubs and science fairs; through individual counseling; and through other activities. This is an effort by engineers for their profession. This is a professional activity which is not intended to favor particular industries or technical specialties. Rather, the effort is directed toward strengthening the engineering profession so that it may be equal to the task of keeping our technical progress moving forward.

Because not all high-school students have the necessary aptitudes, and since it is necessary to interest the qualified to enter engineering colleges, help is needed at the local level to adequately carry on these guidance activities. There is a place and a need for all engineers who are interested to engage in this work. ECPD asks the members of ASME to volunteer their assistance in this effort.

To facilitate ASME members in this worthy cause, we list the Regional chairmen.

Region I, E. Donovan, University of New Hampshire, Durham, N. H.
Region II, Herbert F. Roemmele, Dean of Students, Cooper Union School of Engineering, New York 3, N. Y.
Region III, F. J. Jeffers, Baltimore Gas & Electric Company, Baltimore 3, Md.
Region IV, J. H. Lampe, Dean of Engineering, North Carolina State College, Raleigh, N. C.
Region V, H. P. Skamser, College of Engineering, Michigan State University, East Lansing, Mich.
Region VI, John Gammell, director of Graduate Training, Allis-Chalmers Manufacturing Company, Box 510, Milwaukee 1, Wis.
Region VII, Robert Matteson, California Research Corporation, 200 Bush Street, San Francisco, Calif.
Region VIII, C. L. Svensen, secretary, State Board of Registration for Professional Engineers, 308 West 15th Street, Austin 1, Texas.

For the Regions outside continental U. S., R. F. Shaw, Vice-President, Foundation Company of Canada, Ltd., 1900 Sherbrook St., W., Montreal, Canada; and Marsh W. Ball, P.O. Box 3256, Honolulu, T. H.

ASME Symposium to Discuss Role of Viscosity in Lubrication

How sensitive are machines to the viscosity of the oil used to lubricate them? What criterion do designers use in selecting the vicosity of the oil for which machine bearings are designed? These and other practical questions concerning the role of viscosity in lubrications will be discussed at a two-day symposium sponsored by the Lubrication Division of The American Society of Mechanical Engineers, March 10 and 11. The Symposium will be held at the Socony Mobil training center, 150 East 42nd Street, New York City. Meetings will run from 9:30 a.m. to 5:00 p.m. All interested in lubrication are urged to attend.

The first session will deal with factors affecting viscosity and will include: "Effect of Temperature on Viscosity," by H. H. Zuidema, Shell Oil Company; "Effect of Pressure on Viscosity," by E. M. Barber, Texas Oil Company; and "Effect of Rate of Shear on Viscosity," by Allen Beerbower, Esso Standard Oil Company.

The sensitivity of machines to viscosity change will be covered by R. C. Garretson, Westinghouse Electric Corporation; Charles Bailey, U. S. Steel Corporation; J. H. Hitchcock, Morgan Construction Company; and K. G. Henrikson, Socony Mobil Oil Company.

The criterion used by engineers in selecting viscosity of the oil for which machine parts will be designed will be covered by William M. Kauffman for pistons and other parallel surfaces.

The last session will be devoted to a general summary and discussion of the problems raised in the previous sessions.

ASME CODES AND STANDARDS WORKSHOP

B16.5 Revision Published

THE new revision American Standard Steel Pipe Flanges and Flanged Fittings, B16.5-1957, is now available from the Society. This revision has deleted the Class B pressure-temperature ratings and has clarified the remaining ratings formerly Class A. An appendix is included to define gasket qualifications (other than ring joint) suitable for pressure-temperature ratings in the standard. Another appendix defines the methods of calculating bolt lengths. Pressure-temperature data have been added for additional materials. Copies are available at $3 from The American Society of Mechanical Engineers, Order Department, 29 West 39th Street, New York 18, N. Y. (20 per cent discount to ASME members.)

New Standards

The following revised standards are with the American Standards Association and approval is expected shortly:

Machine Pins—B5.20-

Mounting Dimensions of Lubricating and Coolant Pumps for Machine Tools—B5.28-

Markings for Grinding Wheels and Other Bonded Abrasives—B5.17-

Draft Standard on Involute Splines, Serrations and Inspection

B5 Technical Committee No. 13 is currently undertaking revision of the three B5 splines standards. It is their intent to arrive at one standard incorporating what was formerly in the three separate standards. Single copies of a portion of this revision are now available on request for the purpose of eliciting comments from industry. Requests should be directed to The American Society of Mechanical Engineers, Standards Department, 29 West 39th Street, New York 18, N. Y.

Officers Named for Sectional Committee B76

S. F. DesMarais, E. I. du Pont de Nemours & Company, Inc., has been appointed chairman of Sectional Committee B76 on Standardization of Cooling Towers. J. H. Bateman of the Marley Company has been named vice-chairman. The Sectional Committee was recommended by a General Conference, called as a result of a request by the Chemical Committee Advisory Board of ASA. The scope of the committee at present is as follows. "The establishment of standards for cooling towers. In establishing these standards, consideration shall be given to:

(*a*) performance-testing procedures,
(*b*) materials for construction, including preservative methods,
(*c*) mechanical components,
(*d*) safety requirements,
(*e*) water treatment,
(*f*) fire protection,
(*g*) performance analysis, and
(*h*) dimensions."

Eight subcommittees have been appointed with the following chairmen:

Subcommittee 1—Performance Testing Procedures, E. C. Smith, Hudson Engineering Corporation

Subcommittee 2—Materials, W. R. Thomas, Carbide & Carbon Chemicals Company

Subcommittee 3—Mechanical Components, D. D. Herrman, Hartzell Propeller Fan Company

Subcommittee 4—Safety Requirements, Henry G. Strong, Air Conditioning and Refrigeration Institute

Subcommittee 5—Water Treatment, J. L. Powell, Union Carbide Nuclear Company

Subcommittee 6—Fire Protection, H. C. Cranick, Factory Insurance Association

Subcommittee 7—Performance Analysis, Donald M. Vestal, Texas Agriculture and Mining College

Subcommittee 8—Dimensions, John R. Buss of the Monsanto Chemical Company

At the request of one of the sponsors the subcommittees have been asked to make a formal report to the Sectional Committee on the feasibility of standardization in their assigned areas.

Frank Xavier Gilg

It is with deepest regret that word was received on Jan. 26, 1958, of the death of Frank Xavier Gilg, Mem. ASME, member of the Boiler and Pressure Vessel Committee.

S. F. DesMarais

J. H. Bateman

Mr. Gilg was executive assistant of the Boiler Division of The Babcock and Wilcox Co. and, in addition to being a member of the Main Committee since 1954, he served on the Subcommittee on Care of Steam Boilers in Service, the Subcommittee on Power Boilers and the Executive Committee, as well as many Special Committees and Subgroups. He was chairman of the International Standards Organization Committee for the Unification of Boiler Codes and was leader of the American delegation at the international conference in Paris in May, 1953, to develop this Code.

Mr. Gilg was the author of many technical papers on boilers, stokers, and furnaces and held patents on boilers, superheater construction, and special designs. He served on the Advisory Committee of the National Board of Boiler and Pressure Vessel Inspectors and was a member of the Council of the Uniform Boiler and Pressure Vessel Laws Society, Inc.

His other affiliations included the American Society for Testing Materials, American Boiler Manufacturers Association, Air Pollution Control Association, American Standards Association Sectional Committee B16, and the International Institute of Welding.

The members of the Boiler and Pressure Vessel Committee at their February meeting expressed their feeling of deep loss in Mr. Gilg's death and extended their sympathy to his family.

F. X. Gilg

Code Requirements for Brazing Now Included in ASME Boiler & Pressure Vessel Code

Rules have now been adopted by the Boiler and Pressure Vessel Committee and added as a new Part C to Section IX, Welding Qualifications, to cover brazing.

The rules in this section of the Code apply to the qualifications of brazing procedures, and brazing operators engaged in brazing under the Code. The brazing processes covered are: Manual Torch Brazing, Furnace and Mechanized Torch Brazing, Induction Brazing, Electrical Resistance Brazing and Dip Brazing—Salt and Flux Bath.

Its many tables and figures include grouping of brazable materials for procedure qualifications and brazing alloys for procedure and performance qualifications, type and number of test specimens required, brazing positions and dimensions of test plates. The Appendix includes recommended forms for manufacturer's record.

This section is included in the winter, 1957, pink sheet Addenda issued Jan. 25, 1958, and is available from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
[Agency]

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
8 West 40 St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Process Engineer, BME; 29; experienced in producing sound castings in sand, shell, and investment casting media—both ferrous and nonferrous alloys, five years; also experienced in design of soft-metal dies and all inspection procedures including metallurgical, x-ray, zyglo, and magnaflux. Prefers metropolitan New York or Long Island. Me-513.

Engineering Management, BEE and BME; 40; PE; two years project manager design, fabrication, installation large domestic and foreign nuclear reactors; 13 years electromechanical plant engineering. Heavy on design, fabrication, plant layout, installation and maintenance, large and heavy mill equipment; three years electrical engineer in steel mill research and development. Prefers U. S., with exception of deep South; will consider Florida. Me-514.

Chief Engineer, BME, MME, PE; 36; ability to organize and direct varied engineering or manufacturing functions. Consultant to design and manufacturing engineers for economic designs and manufacturing feasibility with 17 years' industrial experience. Taught design and manufacturing at several universities for seven years. Prefers northern N. J., or New York City. Me-515.

Mechanical Engineer, BME; 40; 19 years' diversified shop, engineering consulting, and administrative experience in U. S. A., Hawaii, Greenland, and South America. Heavy experience in design, development, and management. Location, optional. Me-516.

Designer, BS (ME); 25; 1½ years as enlisted man in U. S. Army under Scientific and Professional Program as project engineer handling design, specification writing, and estimating of small government contracts. Prefers New York City. Me-517.

Plant Engineer, BSME; 35; 12 years including drafting, junior engineer, maintenance foreman, assistant to plant engineer, assistant maintenance-department head, and maintenance engineer, all in chemical plants; 10 years with present company. Prefers South, East, or Midwest. Me-518.

Research or Development Engineer, MS (ME); 35; 11 years' experience involving calculations of springs, steam and gas flow, cams and linkages, dynamics, electric circuits, stress and deflections, small turbines, sleeve bearings, thermochemistry; testing of fire extinguishers and detectors, pneumatic devices; extrusion of compounds; design of test oven; use of pulse timer, environmental specs; supervision of wiring; data reduction. Prefers New York City or northern N. J. Me-519.

Factory Manager, 55; 20 years' experience in plant management and top-level staff. Single and multiplant operations. Metalworking, building materials, assemblies, abrasives. Ability in organization, management controls, labor relations. Location, optional; except metropolitan New York. Me-520.

Designer, R&D, Ph.D.; over 40. Design, development, heat-treating cabinets, gadgets,

[1] All men listed hold some form of ASME membership.

1958 ASME Regional Student Conferences

Region	Host	Place	Date
I	Massachusetts Institute of Technology	Cambridge, Mass.	April 11–12
II	New York University	New York, N. Y.	March 29
III	Cornell University	Ithaca, N. Y.	April 18–19
IV	Vanderbilt University (Hermitage Hotel)	Nashville, Tenn.	April 11–12
V	University of Detroit	Detroit, Mich.	April 11–12
VI	Marquette University Northern Tier	Milwaukee, Wis.	April 18–19
VI	University of Notre Dame Southern Tier	Notre Dame, Ind.	May 2–3
VII	University of British Columbia Northern Tier	Vancouver, B. C.	May 2–3
VII	University of Santa Clara Southern Tier	Santa Clara, Calif.	April 18–19
VIII	Kansas State College Northern Tier	Manhattan, Kan.	April 28–29
VIII	New Mexico A&MA Rocky Mountain Tier	State College, N. Mex.	April 11–12
VIII	Southern Methodist University Southern Tier	Dallas, Texas	April 25–26

miscellaneous projects, two years. Three years apprenticeship major electromechanical manufacturer—machine operator, assembly work, methods, and procedures. Five languages including Spanish. U. S. citizen. Prefers New York area. Me-521.

Industrial Engineer, BSAdE; 30; spring industry (furniture) $2^1/_2$ years; steel construction, 1 year; power-transmission equipment, 1 year. Prefers New York metropolitan area. Me-522.

Sales or Executive Manager, BSME; 45; 20 years' sales management, engineering, production, and cost experience in the fabrication of corrosion resistant process equipment for the chemical, petroleum, pharmaceutical, and AEC field. Prefers New York metropolitan area. Me-523.

Chief Engineer, PE; 45; 25 years' production, design, research and construction, broad mechanical, electrical, and electronic experience. Prefers continental United States. Me-524.

Design and Development Engineer, BSME; 29; $4^1/_2$ years' aeromechanical-engineering design experience. Held supervisory position in the engineering department of a major company. Experienced in administration and scheduling of engineering assignments. Location, optional. Me-526.

Export Manager and/or Representative, BS; 35; four years with heavy steel-mill equipment export company, in charge of Mexican office and operations in contact with Mexican steel industry. Prefers Mexico, Latin America. Me-527.

Administrative Engineer, ME; 32; registered; seeks responsible position where advanced management and manufacturing techniques could be applied to advantage. Diverse background in administration, product industrial and manufacturing engineering, production control, production, cost accounting, procurement, maintenance, etc., in metal-products manufacturing. Location, optional. Me-528.

Design or Project Engineer, BME, MS; 32; $4^1/_2$ years design of petroleum refineries and chemical plants; 4 years machinery manufacturers, testing, development, application work; 3 years Naval officer, engineering experience. Prefers New York metropolitan area. Me-529.

Production Trainee, BSME; 24; summer laborer during high school. Three years Engineer Officer aboard U. S. destroyer; 80 men in department. In charge of all mechanical equipment excluding armament. Location optional. Me-530-859-Chicago.

Sales or Development Engineer, BSME; 30; $3^1/_2$ years selling controls to gas-appliance manufacturers in northeastern United States; 3 years design and development of gas-fired heating equipment. Limited travel. Prefers Midwest or East. Me-531-854-Chicago.

Chief Engineer-Mechanical, BME; 20 years' experience. Capable of handling project through concept, research, design, development, and production. Experience includes heavy corrugated paper-box machinery, machine tools, rocket engines, valves, electromechanical devices, facsimile wire photo. Prefers New York metropolitan area. Me-532.

Mechanical Engineer, BME; 29; seven years' experience in design, construction, operation of centrifugal and permanent molds for aluminum castings. Supervisory position three quarters of this time. Prefers Detroit area or Northeast. Me-533-Detroit.

Project Engineer, 29; development machines, design of production and custom commercial atomic energy products, five years. Centrifugal pump manufacturing, extensive foundry, and machine-shop experience. S-177-Mech.

Positions Available

Project Mechanical Engineer, ME, graduate, at least five years' special machinery design, specification, and installation experience covering large radars and motor-driven equipment including structural stress-analysis work. $10,000. New York, N. Y. W-5762.

Plant Manager, Mechanical Engineer, at least ten years' production and managerial experience covering industrial boilers, heat-exchangers, and fabricated steel products. Either Portuguese, Spanish, or German desirable but not essential. $15,000–$18,000, plus bonus, housing, and transportation. Brazil. P-5765.

Staff Consultant, Management Controls, engineering graduate, preferably advanced courses in business administration and three to five years' experience covering budgets, standard costs, and various financial controls. Moderate traveling. $8000–$12,000. New York, N. Y. W-5770.

Engineer, Maintenance Supervision, at least five years' supervisory operating experience in industrial steam-power plant, chemical processing, equipment, and building maintenance. Must have power-plant license. $8000–$10,000. N. J. W-5780.

Writer, Graduate Mechanical Engineer, some experience in writing both for technical publications and for brochures, pamphlets, instruction sheets, etc., for the oil-field materials business. Company will train if applicant shows writing ability. Southwest. W-5782.

Sales Engineer, mechanical graduate, early 30's, to sell small industrial boiler installations to OEM, consumer applications, etc., in Bronx and Westchester County. $7200–$8000, plus bonus and expenses. W-5784.

District Managers or Sales Representatives, two preferably college graduates, 25–40, minimum of three years in sales or operating in gas-transmission or distribution industry, or in pipe-coatings sales. Will be responsible for sales to gas industry, both transmission and distribution. $7500–$10,000 plus bonus, potential to $12,000. One for Kansas City or Minneapolis; one for Dallas or Houston, Texas. W-5789.

Engineers. (*a*) Departmental engineer, graduate mechanical or equivalent, 28–45, five years in metalworking industry, preferably in production engineering or shop supervision. Experience should include one or more of the following: welding, forging, cold forming. Will be responsible for liaison between manufacturing-engineering department and production department on matters of tooling and tool control. $7200–$8400. (*c*) Tool design and drafting supervisor, graduate mechanical or equivalent, to 50, five to ten years' practical experience in tool design, preferably with supervisory experience. Will provide tool designs and drawings needed for production metalforming operations, i.e., welding, machining, forging, etc. To start, $6600–$8400. Northwestern Pa. W-5790.

Engineers. (*b*) Project engineer, 27–50, graduate mechanical, minimum of five years' machine-design experience, preferably in air-moving equipment. Will be responsible for rotary vacuum-pump design. $7000–$9000. (*c*) Project engineer, graduate mechanical, 27–50, minimum of five years' machine-design experience, preferably in air-moving equipment. Will be responsible for multistage centrifugal blower design. $7000–$9000. Southeastern Ind. W-5791.

Design Engineers. (*a*) Senior design engineer, graduate mechanical, 25–50, minimum of three years in machine design, preferably air-moving equipment. Will be responsible for structural and mechanical design of multistage centrifugal blowers. $6500–$8500. (*b*) Design engineer, graduate mechanical, one to two years' machine-design experience desirable but not essential. Will be responsible for structural and mechanical design of single-stage centrifugal blowers. $5600–$7200. Southeastern Ind. W-5793.

Engineers. (*a*) Project manager, 35–45, graduate mechanical or marine engineer, to report directly to chief engineer. Will be responsible for all mechanical-engineering design for construction of tankers and cargo ships. Must have ten years' experience in marine-engineering field or in large stationary power-plant design. Work will include preparation of specifications, material and equipment analyses, estimating costs, setting up test program for completed power plant and auxiliary equipment. $10,000–$14,000. (*b*) Project engineer, power plant, 30–40, graduate mechanical or marine engineer, minimum of five years' experience in marine engineering or in large stationary power-plant design. Will be responsible for power-plant engineering work in the design of ocean-going tankers and cargo ships. Work will include preparation of power-plant specifications, preparing heat balances, compiling specifications for ordering boilers, main-propulsion turbines, etc. $9000–$12,000. Pa. W-5801.

Engineers. (*a*) Machinery engineering supervisor, MS (ME) desired, at least 12 years in design and manufacture of rotating or reciprocating machinery, broad understanding of engineering and shop practice. Will be responsible for technical excellence and design policy of products, and to determine and co-ordinate machinery programs, etc. To $12,000. (*b*) Pressure-vessel engineering supervisor, MS (ME) desired, at least ten years' experience in the design and manufacture of heat exchangers and pressure vessels, good understanding of engineering and shop practice. Will supervise planning and scheduling of work, and coordinate manufacturing and engineering problems. To $10,000 a year. Pa. W-5806.

Sales Engineers. (*a*) Sales engineer, senior BS in mechanical or chemical engineering, 28–38, minimum of five years' experience in the sale of capital goods to the chemical industry. Must have good working knowledge of chemical processes and chemical-plant operations. To $12,000. (*b*) Sales engineer, senior, 28–38, BS in mechanical or chemical engineering, with a minimum of five years' experience in the sale of capital goods, preferably in sales to the steel industry. Should have

good knowledge of steel-mill processes such as combustion, operation of blast furnaces, open hearths, electric furnaces, Bessemer and oxygen converters, etc. To $12,000. (*c*) Sales engineer, senior, 28–42, BS in chemical or mechanical engineering, at least five years' experience in the sale of U. S. manufactured capital goods to foreign markets. Must have good knowledge of international trade procedures. Will initially maintain contact with U. S. based representatives of foreign firms and will travel about 50 per cent of time. May in the future be required to travel world wide to negotiate sales. Headquarters, Pa. W-5807.

Vice-President—Sales, graduate, to direct sales of large manufacturing company to process industries, power utilities, and consulting engineers. Experience in effective market research, forecasting, and sales-promotion techniques. $18,000, plus stock-option participation and profit sharing. East. W-5808.

Chief Engineer, graduate mechanical, experienced engineering manager, to direct research and development program; strong background in metallurgy and the design and application of steam power-plant equipment. $15,000 plus rofit sharing. Only East. W-5809.

Chief Mechanical Engineer, graduate mechanical, to supervise an engineering-design and drafting room for company manufacturing noise-control equipment for aeronautical industry. Should have experience in structures, piping, mechanics of fluids, fabrication. $10,000–$12,000, plus profit sharing. New York, N. Y. W-5811.

Sales Manager, graduate mechanical or chemical, 35, some sales experience and experience in the use and application of hydraulic equipment. South. W-5813.

Chief Performance Design Engineer, at least 15 years' design experience; will be responsible for the aerodynamic and thermodynamic design of military and commercial turbo machinery, including superchargers and small gas turbines. Will supervise a group of approximately 15 engineering specialists in the fields of fluid mechanics, internal aerodynamics, combustion, thermodynamic-cycle analysis, and controls. Will report to manager of engineering and work closely with project engineers and mechanical designers. Salary open, commensurate with experience and background. Company pays placement fee. Ohio. W-5825.

Sales Manager, 40–55, engineering degree desirable. Should have been general sales manager or at least assistant sales manager. Product background in blowers, steam turbines, superchargers, reciprocating machines, or any fluid-moving equipment of the capital-goods type. Will direct all sales activities, including field sales, market research, sales planning and forecasting, application engineering, and service. Will supervise, through subordinate managers, a total staff of 50–60, including 24 field-sales people. Will report directly to president. $20,000–$24,000, plus bonus. Southeastern Ind. W-5832.

Assistant Professor, Industrial Engineering, recent MS with PhD preferred, knowledge of operations research, application of statistics to industrial-engineering problems, interest in research and development of graduate program. Position available in September, 1958. New England. W-5838 (*a*).

Refrigeration Engineer, preferably graduate mechanical, to engineer and develop various assigned projects pertaining to a line of small commercial refrigerators and related accessory items. Will set up, supervise, and report on hot-room tests for various performance standards; work in close liaison with methods engineering and general engineering. Should have a knowledge of and experience in refrigeration, preferably in fractional hp range; knowledge of theory and application experience of all related refrigeration components, such as temperature and pressure controls, thermostatic expansion valves, solenoid valves, capillary tubes, etc. $7500–$8000. Upstate N. Y. W-5841.

Sales Engineer, mechanical-engineering training and at least two years' field-sales experience in New York area, covering centrifugal pumps and reciprocating compressors. $5000, plus commission and expenses. W-5843.

Design Engineer, graduate mechanical, no experience necessary, for piping and pressure-vessel design. Work will be in field of high-energy fuels. Must be U. S. citizen and capable of passing security check. Company pays placement fee, relocation expenses, and interviewing expenses. Pa. W-5847.

Engineers, field of high-energy fuels. Must be U. S. citizens and capable of passing security check. (*a*) Instrument engineer, graduate mechanical or electrical, three years' minimum ex-

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print

ASME Master-File Information

Date

LAST NAME _____ FIRST NAME _____ MIDDLE NAME _____

POSITION TITLE _____ NATURE OF WORK DONE _____

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) _____ Division, if any _____

*☐

EMPLOYER'S ADDRESS _____ City _____ Zone _____ State _____

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER; e.g. Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐

HOME ADDRESS _____ City _____ Zone _____ State _____

☐

PRIOR HOME ADDRESS _____ City _____ Zone _____ State _____

* CHECK "FOR MAIL" ADDRESS

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Address changes effective when received prior to:

☐ MECHANICAL ENGINEERING	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ U—Maintenance and Plant Engineering
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	
	☐ R—Railroad	

perience in application of analytical or process-control instrumentation in chemical or petrochemical plants. Will work on development and application of standard and special process control equipment. (*b*) Mechanical engineer, graduate, minimum of two years' work experience, preferably three years or more in chemical-plant maintenance or trouble shooting. Will do mechanical trouble shooting, performance testing, equipment development, mechanical performance evaluation, standard specification writing. Company pays placement fees, relocation expenses, and interviewing expenses. Pa. W-5848.

Engineers, field of high energy fuels. Must be U. S. citizens and capable of passing security check. (*a*) Project engineer, mechanical or chemical graduate, minimum of three years chemical-plant work in production, maintenance, or construction. Will take charge of construction or modification of projects; co-ordinate, plan, schedule, and supervise project work. (*b*) Design engineer, graduate mechanical, seven or more years in piping and pressure-vessel design. Will do detailed design of piping, vessels, and special equipment. Company pays placement fees, relocation expenses, and interviewing expenses. Pa. W-5849.

Research and Development Engineers. (*a*) Mechanical engineer, preferably advanced degree, knowledge of gas dynamics, thermodynamics, and heat transfer, minimum of five years' experience in the steam-turbine field; plus ability to conduct independent research and development work on steam turbines. (*b*) Mechanical engineer, preferably advanced degree, with similar related experience in compressors. Salaries open. N. J. W-5851.

Instructors, mechanical engineering, graduate mechanical, preferably some teaching experience. School year eight and one-half months. Salary depending upon qualifications. Positions available in September, 1958. Pa. W-5852.

Chief Industrial Engineer, 25–35, graduate industrial engineer, major in industrial economics, manufacturing, cost accounting. Prefer five to six years' experience. $8820–$10,800. Westchester County, N. Y. W-5854.

Designer, mechanical, metallurgy background, to design a furnace for melting of metals in high vacuum. Temporary, six to 12 months, possibly permanent. $7200–$10,000, plus per diem living expenses. New England. W-5857.

Branch Manager, branch sales office; degree in mechanical, industrial, or chemical engineering and some prior sales-management experience. Experience in selling mechanical heating and ventilating equipment in New York City at the consulting engineering company level desired. Will sell, particularly at the specification level, line of heating and ventilating products; will supervise sales activities of sales engineers, etc. Salary in five figures with a substantial bonus based upon sales volume and profit made by branch office. Territory, greater New York City, Long Island, and Westchester County. W-5860.

Industrial Engineer, 30–40, to estimate production times, make production routings, including selection of machine tools to be used, types of fixtures and tools required for job. Set up time standards for cost control. Analyze methods for improvements. Apply statistical-control procedures where applicable. $7200. Southwest. W-5863.

Patent Attorney, mechanical-engineering background preferred, to prepare and prosecute applications for letters patent, trade-mark registration, and copyright by obtaining from personnel, information necessary for such applications, prepare and file the application, and prosecute the application to a final conclusion. Render opinion on scope, validity, infringement and title of patents, trade-mark registrations and copyrights of the company, and of others. Minimum of two years in this field. $8000–$10,000. Upstate N. Y. W-5865.

Cable Engineer, at least three years' experience in design, development, and production of multiconductor cables. Electrical or mechanical engineering required. Will approve customer specifications and interpret same for quotation department, issue manufacturing specifications, supervise all cable operations on an engineering level. Will report directly to chief engineer. To start, $7000–$9000. Conn. W-5868.

Plant Personnel. (*a*) Chief inspector, young, educational background and work experience in the textile field, ability to train and develop an inspection staff. Must have knowledge of modern quality-control techniques and have ability to make decisions. $5400–$8580. (*b*) General foreman, plant and equipment maintenance. Must be familiar with plant engineering and the set-up, operation, and maintenance of specially designed production machines and equipment. $5400–$8580. Conn. W-5869.

Machine Designer, mechanical graduate, ten years' experience in design of packaging machinery and mechanisms, to design new machinery for particular applications and improve machines already in use. $9600–$12,000. Company may negotiate placement fee. Northern N. J. W-5874.

Senior Design or Project Engineer, graduate mechanical or electrical engineer, sound knowledge of materials and methods or processes relating to the boiler or pressure-vessel work. Must understand the low-pressure residential and commercial boiler business and the packaging of such equipment in either small boiler-burner units or packaged steam generators. Must be able to calculate the correctness of proportion, stress and efficiency, and such other data as may be required; should be able to prepare design or redesign details for boilers or similar items. $9000–$12,000, plus fringe benefits. Upstate N. Y. W-5883.

Mechanical Engineer, 30–50, BS two to ten years' experience, preferably in the chemical industry, dust-control experience desirable. Duties will involve original estimate, design, and field follow-up on projects. Will participate in long-range programs in expanding engineering design department. $7200–$10,800. Southern Conn. W-5885.

Painting Engineer, chemical or mechanical-engineering graduate, three to five years' experience, for fabricator of capital steel equipment, for work in coatings and painting. Must have had previous experience in this field. Staff work with seven plants. Salary open, depending upon ability and experience; fringe benefits. Midwest. W-5886.

Mechanical Engineer, graduate, to 40, at least ten years' broad experience in materials-handling design. Will co-ordinate application engineering (sales) and design engineering. Good potential. Must have broad administrative possibilities for a manufacturer of heavy equipment. From $12,000. Chicago, Ill. C-6664.

Project Co-ordinator, over 35, civil engineering, architectural, or equivalent degree. Minimum of ten years' experience in field of large industrial building projects covering co-ordination of client, design engineer, and contractor functions. Salary open. Midwest. D-4366.

Development Engineers, Test-Missile. (*a*) Mechanical; (*b*) Electrical; recent graduates to well experienced, background or experience in missile-test-stand systems and controls, involving instrumentation, electronics, mechanical-hydraulic-pneumatic devices; able to prepare and deal with normal electromechanical schematics and involved firing process for the purpose of calibrating and adjusting missiles for static flight tests. Ideal climate and living. Recent graduate, $6000; three to five years' experience, $7200–$8400; to $12,000 a year and up. Relocation cost and placement fee paid. Security clearance required. Calif., northern Valley area. S-3330.

Draftsmen, Conveyers, mechanical background, young, to prepare installation, construction, shop, and assembly plans and details for maior, minor, and intermediate power, and to treat with mechanical (linkage, mountings, and gear reducers) components, light structural frames, electric motors, controls (hydraulic-air-electric-electronic) for manufacturer. $5400–$6000. Desirable climate and living in San Francisco Peninsula. S-3331.

Methods and Process Engineer, Drug Products, industrial or mechanical, young, recent graduate or some work experience, able to assist in examination, evaluation, utilization, report, and recommendation of production facilities to improve product and performance; involving charting, time-and-motion study, methods and process on machines, equipment, systems, and processing of pharmaceutical and biological products. $5400–$6000. San Francisco East Bay. S-3332.

Plant Engineer, Meats, mechanical, electrical, or architectural, young, recent graduate, up to three years' experience, to assist in maintenance, modifications and expansions in large plant; interest in and ability to deal with mechanical, electrical, and architectural aspects. Will work in plant and engineering department with plant personnel, contractors, architects, and engineers on plans, specifications for meat packer. Desirable climate and living. Recent graduate, $5400; with experience, $6300. San Francisco Peninsula. S-3333.

Aeronautical Engineer-Teacher, graduate, advanced degree, either young June graduate or man with MSAe and some experience, to teach basic courses in aerodynamics and structures. Salary and rank depend upon qualifications. Opportunity for consulting engineering. Available September, 1958. Southern Calif. S-3346.

Engineering Teachers. Preferably teaching experience, several years' engineering experience, registered, advanced degrees. (*c*) Mechanical engineer to teach engineering drawing, applied mechanics, metallurgy, and hydraulic machinery; assist in development of new mechanical-engineering curriculums. Salary depends on experience and training. Available Sept., 1958. Calif. S-3347.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after March 25, 1958, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and • Transfers

Alabama

• PHILLIPS, JAMES S., Mobile
WARD, BENJAMIN P., Auburn
WILBANKS, JAMES R., Auburn

Arizona

• YAPPEL, A. RALPH, Tucson

• Transfer to Member or Affiliate.

Arkansas

• THOMPSON, JACK W., Little Rock

California

GOODELL, JACK H., Anaheim
• KRUGER, RICHARD J., Emeryville
KYLE, ALVIN, South Gate
LARSON, LAWRENCE C., Sylmar
LLEWELLYN, CLAY H., JR., Azusa
MURPHY, JAMES J., Santa Clara
SCHULZ, JOHN D., Wilmington
VOTTERI, ALEXANDER C., Sacramento
WILLITS, RALPH M., Los Angeles

Colorado

• BAKER, KEMPER W., Colorado Springs
HAWKINS, SAMUEL H., Denver

Connecticut

BANKS, JOHN L., Stratford
BOGINA, IVAN F., E. Hartford
DOMOROD, WALTER, Groton
FARNSWORTH, WILLIAM T., Hartford
RIFKIN, ERNEST, Groton
ROBERTS, FREDERICK W., Fairfield
WILCZENSKI, ADAM M., Torrington

District of Columbia

ALEXANDER, DAVID O., Washington
CALLAHAN, JOHN W., Washington
CHADENET, BERNARD, Washington
SIGNORELLI, JOSEPH A., Washington

Florida

MCKISSOCK, GEORGE D., Panama City

Georgia

BENSON, ALEC, Savannah
OETGEN, WALTER F., JR., Savannah
WHITE, DONALD L., Marietta

Illinois

CHAMBERS, HARRY L., Metropolis
DONKLE, LUCIUS B., JR., Wheaton
FRANKLAND, GEORGE E., Albion
• FRIEDMAN, SANDER B., Skokie
KOOPMAN, JOHN G., Joppa
LANE, RUSSELL W., Urbana
MATTOCKS, RAYMOND E., East Alton
POETTER, ROBERT K., La Grange
• WOJTAS, GUSTAVE, JR., Des Plaines

Indiana

CRAWFORD, ROBERT G., Indianapolis
LYLE, HORACE P., Hunster

Iowa

• ANDERSON, MARVIN D., Des Moines

(*ASME News continued on page 156*)

COLOR-PORT

water level gage

gives you . . . two-color readings

. . . low maintenance

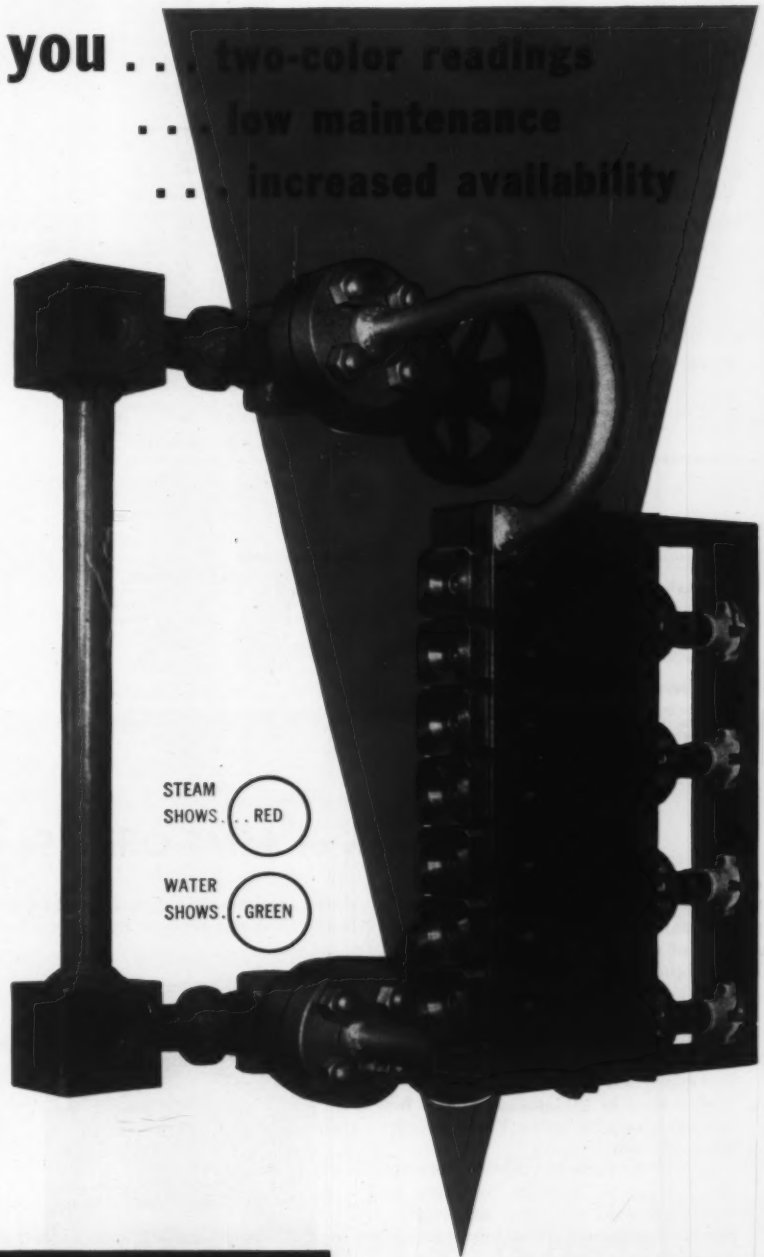
. . . increased availability

You get a *triple advantage* with the Yarway COLOR-PORT boiler water level gage for pressures to 3000 psi.

Two-color readings are brilliant and clear. Water shows green; steam shows red. A full gage is all green and an empty gage all red.

Low maintenance with individual cover-glass assemblies, each held solidly in place by four socket head cap screws. "Floating assembly" design applies safe, predetermined loads on glass ports, reducing thermal shocks, permitting faster warm-up.

Increased availability means longer service life. Cover glass assemblies can be *serviced in place*, easily and quickly.



Yarway Bulletin WG-1814 describes the Color-Port Gage. Write for it.

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Philadelphia 18, Pa.
Branch Offices in Principal Cities

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. . . a good way to specify high pressure water gages

Kentucky

CLORE, THOMAS H., Louisville
FEGENBUSH, MILTON L., JR., Louisville
ZUCKER, ROBERT D., Louisville

Maryland

FALLON, CARLOS, Silver Spring
• HERRMANN, EDWARD M., Annapolis
• KOEN, RICHARD F., Lutherville
PICKER, DUNIBERT, JR., Baltimore
WEBB, ALAN L., Baltimore

Massachusetts

• BARNHILL, KENNETH G., Needham
BROWN, FRANCIS J., Lynn
DISANO, JOSEPH, Springfield
DWINELL, DWIGHT J., Reading
• GUILD, DONALD H., Boston
HILL, WILLIAM J., Worcester
KASLOW, JOHN F., North Andover
KRONAUER, RICHARD E., Cambridge
LIDEEN, LESTER L., Framingham
PATTERSON, ROBERT K., Amherst
RIVERS, RUSSELL C., Boylston
ROSEN, B. WALTER, Lawrence
• SCOTT, KENNETH E., Worcester
SULLIVAN, RICHARD F., Waltham
SWIFT, E. KENT, JR., Whitinsville
WARREN, ROBERT E., Marblehead

Michigan

CLARK, WILLIS M., JR., Ann Arbor
DULL, WILLIAM M., Detroit
GARFIELD, WILLIAM L., Drayton Plains
KENNEDY, ROBERT E., Sault Ste. Marie
LAIRD, ARCHIE H., Detroit
LISSNER, HERBERT R., Detroit
MACLEAN, ROBERT B., Dearborn

Minnesota

CHECCO, JAMES W., Minneapolis
FORKEY, MEDRICK D., Minneapolis
• HOLDHUSEN, JAMES S., Minneapolis
LANGE, FRED F., Minneapolis

Mississippi

LUTKEN, DONALD C., Jackson
WADE, WALTER B., Pascagoula

Missouri

CHRISTIAN, RALPH R., St. Louis
SCHNELL, DONALD F., St. Louis

Nebraska

MCPHERSON, DUNCAN E., Omaha

New Hampshire

TSIMEKLES, GEORGE N., Dover

New Jersey

AGOSTINELLI, ALEXANDER, North Arlington
BANKER, JOHN J., Cranford
BECKER, EUGENE C. H., Bloomfield
CLARKE, JAMES S., Linden
FIEDLER, ALBERT E., Paterson
• GERWIN, EDWARD F., Waldwick
KAUFMAN, SAM, Paramus
LEWIS, GEORGE T., JR., Paramus
MCFARLAND, CHESTER R., Hightstown
NIELSEN, EDGAR W., Mountainside
• SLATER, HORATIO N., JR., Far Hills
• SPERR, ALEXANDER C., Kearny
WENDT, PETER G., Westfield

New Mexico

ECKERT, MARTIN W., Albuquerque

New York

ANDERSON, ROBERT O., Akron
• BANACH, HENRY K., Glen Cove
BASS, ALBERT, Long Island City
COOK, ROBERT A., Utica
CROMER, SYLVAN J., Mt. Kisco
DIGHT, DONALD G., Johnson City
GANNETT, MERTON C., New York
HAMMER, SANFORD S., Brooklyn
HARBRECHT, JOHN W., Buffalo
HULLEY, OLIVER S., Hartsdale
JOHNSON, PAUL E., New York
• KARALIS, ALGIRD J., Uniondale
• KING, SHELDON, Kenmore
KOPPI, WILLIAM A., New York
KRAMAR, JOHN W., Corning
LINDGREN, HUGO L., New York
MUELLER, GERHARD O., Schenectady
NORTON, JOHN L., Scotia
• RENZO, PETER C., Westbury
• SCHMITT, WILLIAM C., Rochester
SCHULTZ, EUGENE E., Schenectady
SHEPPARD, GEOFFREY F., New York
• SMILEY, LLOYD G., Poughkeepsie
• THEOCLITUS, GREGORY, Wellsville
YOKANA, ANDRE, New York

Ohio

BOUGHTON, DONALD S., Cuyahoga Falls
DOHRMANN, RICHARD J., Alliance
ESCOLAS, EUGENE J., Columbus
FANNON, ROBERT D., JR., Columbus
FREDRIKS, THEODORE R., Cleveland
GROZIER, JOHN W., Cincinnati
HANEY, DAVID C., Youngstown
MUNGER, FAY E., Columbus
• MURRAY, JOSEPH E., Toledo
• WELCH, CHARLES P., Canton
WILLIAMSON, CARL J., Cleveland

Pennsylvania

• BARTMAN, JAMES S., Portland
BOTTGER, GEORGE E., Johnstown
BROWN, ALEXANDER M., Meadville
CHENOWETH, ROSTEN W., Pittsburgh
CRESAP, MARK W., Pittsburgh
DANNER, GEORGE E., Erie
DAUSTER, JOHN F., Pittsburgh
GUILLO, LOUIS S., West Point
HEINZ, JOHN H., Pittsburgh
HEYL, ROBERT F., Allison Park
• LAUB, RAINER M., Springfield
MELENEY, ROBERT C., Philadelphia
NOLAN, JOHN E., Pittsburgh
SAHLMANN, LOUIS H., Erie
TREDWELL, ALFRED M., JR., Sharon

Rhode Island

KEITH, JOHN V., Warwick
SCHILHANSL, MAX J., Providence

South Carolina

VAN DELDEN, MARTEN O., Rock Hill

Tennessee

BROWN, CHARLES W., Knoxville
NOKES, CHARLES F., JR., Tullahoma

Texas

BOYD, DONALD V., Houston
EMSHOFF, ROLAND W., Dallas
• ESTES, JOHN C., Beaumont
IRSHAID, ABDUL-R, Houston
MOORE, WILLIAM D., Pasadena
ZAMRIK, ISAM Y., Houston

Utah

BAXTER, LELAND K., Provo

Virginia

FELTON, JOSEPH D., JR., Richland
GENTRY, WALTER B., JR., Richmond
KRAUT, GEORGE P., Lynchburg
SPAULDING, NATHANIEL R., Hampton

Washington

• INGERSOLL, HULETT S., Seattle
• IRWIN, EUGENE D., Mercer Island
• WOLFE, HAROLD K., Seattle

West Virginia

BAUGH, RICHARD S., Charleston
CRICKARD, JAMES L., Huntington

Wisconsin

CRIBBEN, JAMES T., Janesville
JACOBS, JOSEPH J., Milwaukee
LIU, YOUNG K., Milwaukee
MARTI, JAY R., La Crosse
NOLAN, DONALD J., Milwaukee
SHUM, JOHN, JR., La Crosse

Foreign

CAMPBELL, ROBERT A., Montreal, P. Q., Canada
CREIGHTON, WILSON L., Don Mills, Ont., Canada
GERBA, VENIAMINS, Toronto, Ont., Canada
GROSSMANN, UGO C., Zurich, Switzerland
• HOLE, HOWARD D., Honolulu, T. H.
JENSEN, PAUL D., St. Marys, Ont., Canada
KNIGHT, JOSEPH, Victoria, B. C., Canada
MARCOTTE, ROLLAND, Beauharnois, P. Q., Canada
MORGAN, CHRISTOPHER R., Maracaibo, Venezuela, S. A.
PENNY, JOHN H., Falcon, Venezuela, S. A.
ROBERTS, REGINALD G., Don Mills, Ont., Canada
THOMPSON-QUARTEY, THOMAS D., Tema, Ghana, W. Africa

Mae Lenen of ASME Office Services, Dies

MEMBERS of The American Society of Mechanical Engineers will regret to learn of the death, on Jan. 24, 1958, of Mae Lenen, head of Office Services at the Society headquarters in New York.

Miss Lenen was born in New York City on Aug. 7, 1901, the daughter of Francis H. and Amelia (Bird) Lenen. She was graduated from the Flushing High School in 1917 and continued her business education at the Packard Commercial School.

In 1919 she came to ASME where her career began as assistant to Laura E. Henderson who was then the Society's purchasing agent. After Miss Henderson's death she worked for F. S. Crowell, assistant office manager, and on April 6, 1936, she started to work for Mr. D. C. A. Bosworth, Controller.

Her responsibilities grew as her capabilities increased so that in the normal course of events she became head of Office Services. Since it was impossible for Miss Lenen to deny a request, at times it was difficult to discern where her work began and where it ended. She was in charge of the stenographic department and such services as stores, duplicating, mail, and registration at the ASME Annual Meetings. She also did a tremendous volume of the purchasing for the Society.

Mae Lenen Pfuhler

No matter how hectic things ever were in the stenographic department when preprints were being prepared for the meetings of the Society, one could depend on Miss Lenen to have the situation in hand quickly. She knew just where to go to have a question answered by the most competent person. She never seemed to be excited, and no matter how taxing a problem was, one knew that when it reached her it would be done

(*ASME News continued on page 158*)

ASME

STUDENT MEMBERS...

ADVANCE

YOUR FUTURE

IN

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WIN EXPENSE PAID TRIPS TO

DETROIT AND NEW YORK

PLUS CASH AWARDS IN 1958

1 CHARLES T. MAIN AWARD

$150 cash prize and trip to New York for the best paper on the subject of "Student Development of Professional Engineering Attitudes and Ethics."

2 OLD GUARD PRIZE

$150 cash award and trips to Detroit and New York

3 UNDERGRADUATE STUDENT AWARD

$25 cash prize plus trip to New York for best paper on an Engineering subject.

4 POSTGRADUATE STUDENT AWARD

$25 cash prize plus trip to New York for best paper on an engineering subject

for rules covering eligibility, preparation and closing dates for these awards

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expeditiously and intelligently, and that the end-product would be a credit to her and those whose work she supervised.

She was a modest person. Few people who worked closely with her knew, for instance, that she had been a champion swimmer and diver; or how much she liked people and seemed to derive her greatest pleasure from the help she could give them—all this quietly performed with a deep interest. She made her home in Beechhurst, L. I., and there too she took an interest in her neighbors and friends through her activities in the Beach Club, the Republican Club, and the Property Owners' Association.

On the 25th of May, 1958, she would have celebrated the thirtieth year of her marriage to George J. Pfuhler, who survives, as does her sister, Lillian Slaton (Mrs. Edwin H.) who is employed at headquarters as assistant to Ernest Hartford, ASME Consultant. An aunt, Mrs. Mary A. Nelson, also survives.

OBITUARIES

Charles Frederick Beckwith (1887–1957), retired executive, A. O. Smith Corp., New York, N. Y., died Dec. 16, 1957. Born, New York, N. Y., Jan. 9, 1887. Education, ME, Stevens Institute of Technology, 1909. Mem. ASME, 1942. Mr. Beckwith developed the first electric gasoline pump for service stations and, in 1925, founded his own firm, Aqua Systems, Inc.; which manufactured equipment for gasoline service stations. He also helped to develop the flotation system for storing and dispensing fuels. In 1937 the gasoline pump division of Aqua Systems was purchased by the Neptune Meter Company of New York. A. O. Smith later absorbed the division and Mr. Beckwith became an executive of that firm, a position which he held until his retirement in 1956. Mr. Beckwith held several patents relating to storage and delivery systems for liquid fuels. He received the Stevens Honor Award in 1955. Survived by his widow, Mrs. Eva S. Beckwith; a daughter, Mrs. Jean B. Miller; a son, C. Gordon Beckwith; and five grandchildren.

Willard Cope Brinton (1880–1957), president, Brinton Associates, consulting engineers, New York, N. Y., died Nov. 29, 1957. Born, West Chester, Pa., Dec. 22, 1880. Parents, Samuel Lewis and Elizabeth (Smith) Brinton. Education, BS(ME), Harvard University, 1907. Married Laura MacDonald Moses, 1920. Assoc-Mem. ASME, 1907; Mem. ASME, 1912. Mr. Brinton had traveled extensively in the United States, Europe, Japan, and China. His studies of European harbors for the Bush Terminal Co., before World War I, led him to recommend the creation of a bi-state New York harbor agency. This recommendation led directly to the formation of the Port of New York Authority in the 1920's. Engineering recommendations made by Mr. Brinton have led to a number of changes of sites and projects in several cities. He had been active in campaigns to restore a number of historic sites. Mr. Brinton held many patents in materials-handling and production-control equipment for large corporations. He was the author of numerous magazine articles and two books on graphic presentation methods. He was president of the Harvard Engineering Society, 1932; was a vice-president and director of the American Statistical Association, 1917; and a member of the Newcomen Society. Survived by his widow, Mrs. Laura M. Brinton; and a brother, Clinton Brinton.

Alfred Charles Buensod (1886–1957), a pioneer in air conditioning, chairman of the board, Buensod-Stacey, Inc., New York, N. Y., died Nov. 25, 1957. Born, New York, N. Y., Oct. 8, 1886. Parents, Henry S. and Lena S. (Rieder) Buensod. Education, ME, Stevens Institute of Technology, 1907. Married Florence Cady Page, 1916. Assoc-Mem. ASME, 1915; Mem. ASME, 1927. Mr. Buensod, during his early career, was engaged in original research and design work relating to the handling of tobacco in cigar machines and direct application of air conditioning in cigar making plants. In 1915 Mr. Buensod joined Carrier Engineering Corp. and developed air-conditioning methods for the curing and conditioning of tobacco which greatly increased the efficiency of tobacco processing and made substantial savings in waste raw material. While with Carrier, Mr. Buensod was also an officer and director of the Tobacco Treating Co. In 1930 he was responsible for the design, installation, and operation of the first single contract for air conditioning involving more than $1 million, this project was for the RCA Building in Radio City. In 1935 he formed Buensod-Stacey Air Conditioning Co., Inc., now known as Buensod-Stacey, Inc. From 1935 to 1957 he continued his research and development in the tobacco field, and a number of patents were issued in his name. Mr. Buensod had been active in the American Society of Refrigerating Engineers and the American Society of Heating and Air Conditioning Engineers, and in 1957 he was elevated to the grade of Fellow of the latter society. He was a registered professional engineer in several states. Survived by his widow, the former Irene Huntington Lewis; a daughter, Susan Jewel; and a sister, Mrs. George Watson, St. Petersburg, Fla.

Warren Winthrop Chapin (1875–1957), consulting engineer, New York, N. Y., died June 6, 1957. Born, New York, N. Y., May 25, 1875. Parents, Henry J. and Elizabeth A. (Christy) Chapin. Education, ME, Stevens Institute of Technology, 1897. Married Guenn C. Matthews, 1922. Mem. ASME, 1917. A specialist in structural design for buildings, Mr. Chapin had practiced as a consulting engineer since 1919. During World War I, he served as a captain in the U. S. Army Ordnance Department. He was a past-president of the Structural Engineers Society of New York. He served the Society as a member of the Committee on Elevator Standardization in 1921. He was a registered engineer in the states of New York and Connecticut.

Eugene Casper Chase (1923–1957), associate professor of mechanical engineering, Brigham Young University, Provo, Utah, died Nov. 12, 1957. Born, Rock Springs, Wyo., June 26, 1923. Education, BS(ME), University of Wyoming, 1947. Assoc. Mem. ASME, 1957.

George Daniels (1930–1957), engineer, Electric Boat Division, General Dynamics Corp., Groton, Conn., died Nov. 9, 1957. Born, Dedham, Mass., May 2, 1930. Parents, Irving Wagner and Margaret (Osgood) Daniels. Education, BS(ME), University of Rhode Island, 1952. Assoc. Mem. ASME, 1952. Mr. Daniels had been a member of Phi Kappa Phi and Tau Beta Pi.

Clair O. Evans (1888–1957), metallurgical research engineer, Phelps Dodge Copper Products Corp., New York, N. Y., died Dec. 8, 1957. Born, Lawton, Mich., Sept., 15, 1888. Parents, Charles A. and Florence A. Evans. Education, high-school graduate. Mem. ASME, 1941. Mr. Evans had been associated with Phelps Dodge Copper Products Corp. for 41 years. Most recently, he had been in charge of research and development of nonferrous alloys for use in condensers and heat exchangers. He was a past-chairman of the ASME Prime Movers Committee and secretary of an ASME Condenser Tube Research Committee. Held a patent covering the extrusion of nonferrous tubes. Survived by his widow, Jean M. Evans.

Guy N. Harcourt (1889–1957), retired vice-president in charge of engineering, Buflovak Equipment Division, Blaw-Knox Co., died Nov. 20, 1957. Born, Wappinger Falls, N. Y., Jan. 12, 1889. Parents, I. T. N. and Anne Elizabeth Harcourt. Education, MS, Massachusetts Institute of Technology, 1911. Mem. ASME, 1947. During World War I, Mr. Harcourt served in the Army Chemical Warfare Service. After the war he worked for chemical companies and had his own business in St. Louis, Mo. In 1929, he joined the Buffalo Foundry and Machine Co., which, in 1945, became Buflovak Equipment Division of Blaw-Knox Co. He had been manager of the New York office of Buffalo Foundry, and was later vice-president of Buflovak until 1954. In 1953 he went to England to survey the organization of a chemical equipment division. Survived by his widow, the former Mrs. Anne Ellis; and daughter by a previous marriage, Mrs. David Brandenburg, Clarksburg, Md.

Frank Hugh Harrison (1899–1957), managing director, Austral Sheet Metal Works, Ltd., Thebarton, South Australia, died Nov. 7, 1957. Born, Port Augusta, South Australia, May 16, 1899. Education, Adelaide University and South Australia School of Mines, Fellowship and Associate Diploma, ME and EE, Diploma Applied Science, Adelaide University. Mem. ASME, 1944. From 1914 to 1943 under the South Australian Railways Commissioner, Mr. Harrison held positions ranging from apprentice to chief mechanical engineer. At this position, he was responsible to the railways commissioner for design, construction and maintenance, and operation of locomotives and rolling stock. In 1944, he was made a Commander of the British Empire (C.B.E.), an order conferred by His Majesty the King.

Edward Everett Lamberson (1887–1957), general superintendent, Production Division, Staten Island Edison Corp., Staten Island, N. Y., died May 28, 1957. Born, Straughn, Ind., Dec. 1, 1887. Education, attended Purdue University, Polytechnic Institute of Brooklyn, Bliss Electrical School, and Pratt Institute. Mem. ASME, 1951. Previous to Mr. Lamberson's association with the Staten Island Edison Corp., he had been employed by J. G. White Engineering Co., and the Brooklyn Edison Co. His work with Staten Island Edison began in 1927 and was interrupted only by his services with the War Production Board in 1942. Mr. Lamberson had been drafted by the President of the United States to serve as deputy chief of the surplus used-equipment sections of the Conservation Division. Mr. Lamberson was a registered engineer in the State of Pennsylvania.

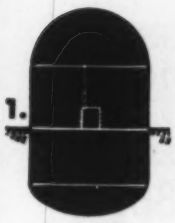
Patrick J. Shouvlin (1863–1957?), whose death recently was made known to the Society, had been president, National Superior Co., Springfield, Ohio. Born, Ardra, Ireland, Feb. 1, 1863. In 1890 with his own company, Superior Gas Engine Co., Mr. Shouvlin designed and manufactured a stationary steam engine. In 1893, he designed and patented his first gasoline engine. The company later became the National Superior Co. of Springfield, Ohio.

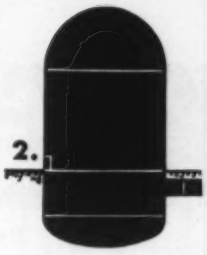
Peter Joseph Shuttleworth (1934–1957), engineer, Proving Ground Division, General Motors Corporation, Milford, Mich., died October, 1957. Born, Detroit, Mich., Dec. 28, 1934. Education, BS(ME), Case Institute of Technology, 1956. Assoc. Mem. ASME, 1956. Survived by his parents, Mr. and Mrs. C. J. Shuttleworth.

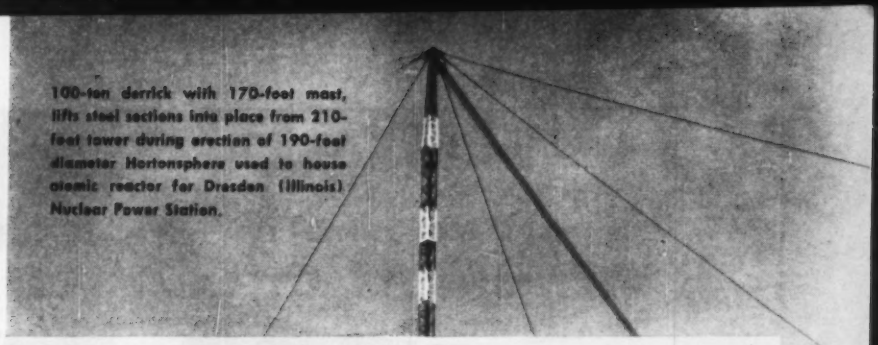
Franklin Sweet (1870–1957), mechanical engineer, The Creamery Package Manufacturing Co., Fort Atkinson, Wis., died Dec. 3, 1957. Born, Manistee, Mich., Oct. 18, 1870. Parents, Benjamin and Julia (Goggin) Sweet. Education, BS(ME), University of Wisconsin, 1893; ME, 1894. Married Carrie Dickinson, 1903. Assoc-Mem. ASME, 1903; Mem. ASME, 1913. Survived by his widow; a daughter, Mrs. William Knueppel; and two sons, Arthur and Wallace Sweet.

Walter Francis Verkamp (1891–1957?), whose death recently was made known to the Society, had been president, The Verkamp Corp., Cincinnati, Ohio. Born, Cincinnati, Ohio, July 4, 1891. Parents, Joseph B. and Clara (Grever) Verkamp. Education, AB, Xavier University, 1911; did postgraduate work in mechanical engineering at the University of Cincinnati. Assoc-Mem. ASME, 1919; Mem. ASME, 1925. In 1914, Mr. Verkamp began a long association with the Ohio Valley Oxygen Co., of which he was secretary, treasurer, and general manager. After the sale of that company in 1930, he organized the Verkamp Corp. for distribution of propane gas and propane gas systems. He also organized the Sparkling Carbonic Co., for manufacture and distribution of carbon dioxide gas.

Edward J. Von Pein (1871–1957?), whose death recently was made known to the Society, had been an inventor with the National Cash Register Co., from 1899 to 1927, and later joined a scale company which was to become International Business Machine Corp. Born, Cincinnati, Ohio, Sept. 16, 1871. Parents, John H. and Etta Von Pein. Education, night school and correspondence courses. Mem. ASME, 1913. With I.B.M., he was in charge of creation, design, and development of the time recorder and industrial scales division. He held over 300 patents on cash registers and related equipment. Survived by his widow, Edith Von Pein, Dayton, Ohio.

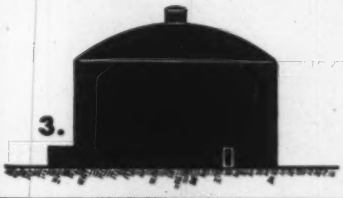


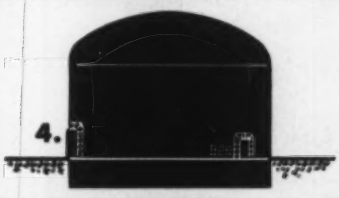


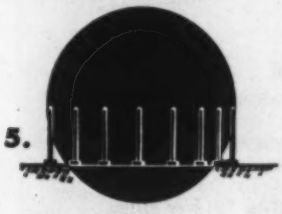


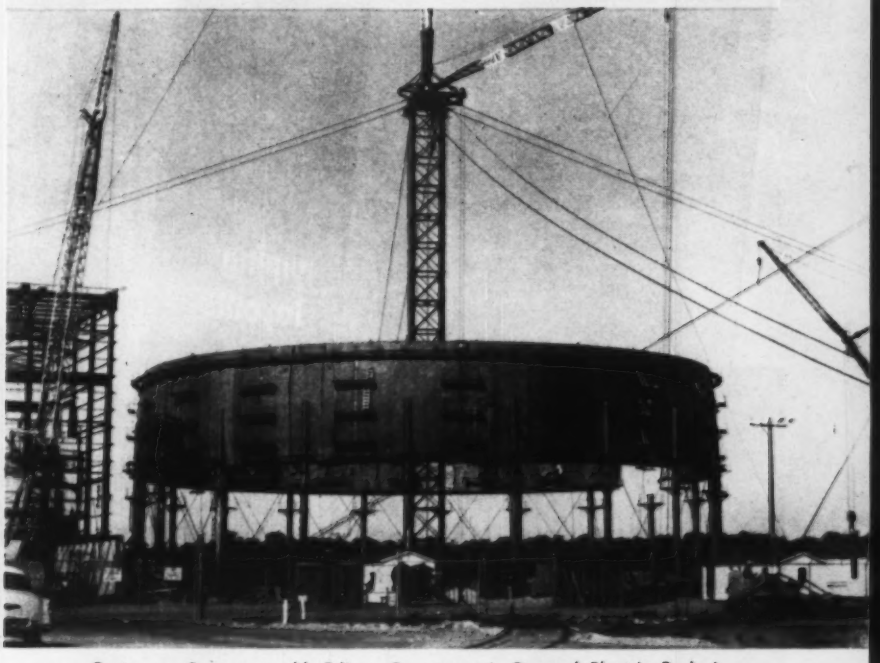
100-ton derrick with 170-foot mast, lifts steel sections into place from 210-foot tower during erection of 190-foot diameter Hortonsphere used to house atomic reactor for Dresden (Illinois) Nuclear Power Station.

SHAPES OF things to come in the atomic age









Customer: Commonwealth Edison Company. A General Electric Project.

CB&I Structures to Silhouette Major Reactor Projects

For CB&I engineers, fabricators and erection specialists, the challenge of things to come in the atomic age is, to a large extent, a reflection of existing accomplishments.

In 1954 the world's largest sphere, a Hortonsphere® measuring 225 feet in diameter, was built by CB&I for the AEC Knoll Atomic Power Laboratory at West Milton, New York, for testing a prototype of the atomic power plant which now serves our atom sub fleet.

Today, near Chicago, a skilled CB&I crew is completing the erection of a 190-foot diameter Hortonsphere to house an atomic reactor for the Dresden Nuclear Power Station. Near Detroit, another CB&I crew erected a reactor containment vessel of a different design for the Enrico Fermi Atomic Power Plant. Silhouettes of similar structures, being designed, fabricated or erected by CB&I, are shown here.

Yes, for CB&I, the shape of things to come in an atomic tomorrow had their beginnings *yesterday*. Experience gained in almost 70 years of furnishing *craftsmanship in steel* to serve Industry, Government and scientific research is now meeting the exacting requirements for reactor containment vessels.

E53CB

1. Enrico Fermi Atomic Power Plant, Lagoona Beach, Michigan. (Power Reactor Development Co., Architect-Engineers)
2. U. S. Air Force, Dayton, Ohio
3. Atomic Energy Commission, Livermore, California.
4. Massachusetts Institute of Technology, Cambridge, Massachusetts.
5. Dresden Nuclear Power Station, Dresden, Illinois. (Bechtel Corp., Constructor-Contractor)

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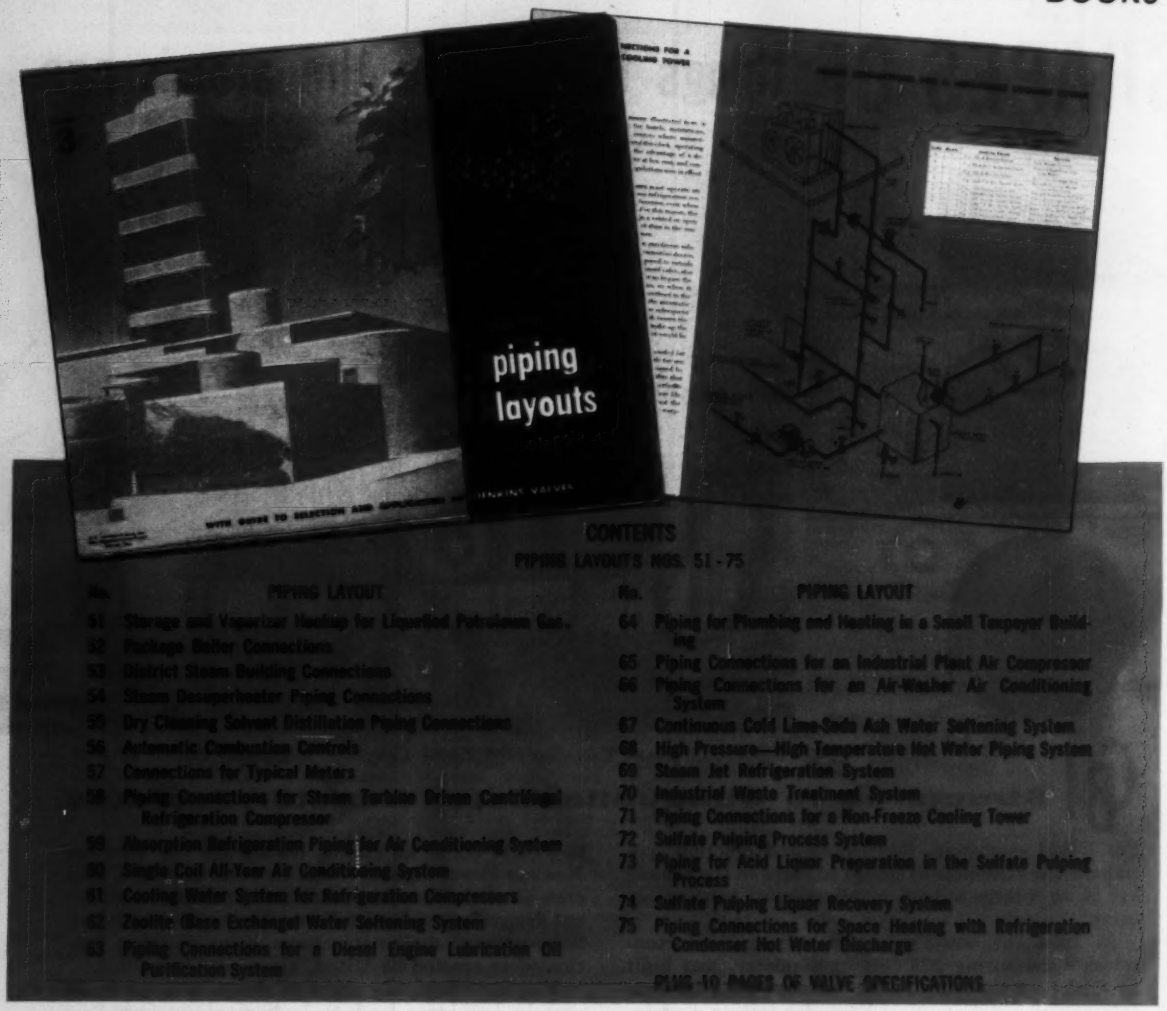
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Volume 3 is a 36-page collection of 25 basic piping diagrams with complete recommendations for valve selection and location in the lines. The material has been prepared by registered consulting engineers in collaboration with the Jenkins Bros. engineering staff and leading equipment manufacturers. It supplements the two booklets released by Jenkins Bros. in past years as a service to consulting engineers, architects, contractors, specification writers and plant operation managers.

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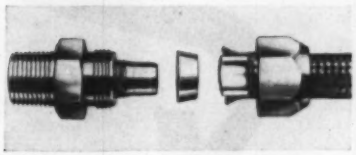
NEW EQUIPMENT

Fluid Filters, Strainers

Ronningen-Petter Co. announces its Multiplex filters in capacities to 3000 gpm for continuous service systems and critical batch type operations.

According to the company, the design of the units permits external parallel operation and eliminates the need for standby or duplicate filtering capacity. The units are said to feature quick-coupling hook-up of inlet, outlet and blow-off and non-short-circuiting filtering elements with continuously closed screening.

The filters are available as single units in three sizes and in multiplex design for virtually any capacity for hot or cold liquids. They are available in copper, bronze, monel, steel, or 316 stainless steel. —K–1



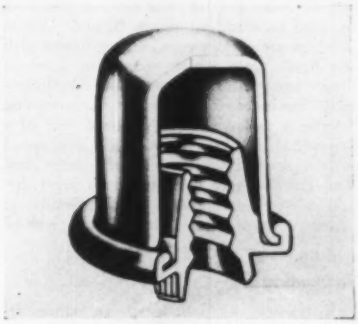
Reusable Fittings

New detachable and reusable industrial fittings for use with Teflon hose are being produced by Titeflex, Inc.

The product designation for the assembly is Springfield 140. The Teflon innercore is reinforced with a stainless steel wire braid to withstand extremely high pressure, the company says, and the hose is chemical and corrosion-resistant in a temperature range of −100 to +500 F.

Each fitting consists of three pieces: compression nut, tapered ring and nipple insert. The nipple insert—the only part of the fitting assembly that is in contact with the fluid—is made of corrosion-resistant stainless steel. The rings are cadmium-plated.

The sealing principle is identical to that approved for aircraft hydraulic and fuel systems at pressures up to 3000 psi, the company says. Sizes range from $\frac{1}{4}$ to $\frac{3}{4}$ in. and include JIC and SAE fittings. —K–2



Capped Clinch Nuts

A new, miniature clinch type self-locking nut, LHCFKM, designed with an integral metal cap has been developed by Elastic Stop Nut Corp. of America.

The firm says the new design was developed for use inside a miniature transformer during the potting operation as a means of preventing the compound from flowing inside the nut threads. For other applications when potting is not involved, the cap can be used to protect closely packed delicate wiring and components from bolt end damage, the company reports.

The fastener is mounted by expanding the short knurled shank in the installation hole. It then becomes a fixed fastener, the firm says, suited for applications where restricted space will not permit normal wrenching procedures or where a blind nut is required to simplify maintenance.

It is available in 4-40, 6-32, and 8-32 threads, with a shank length of .040 for use in material of .030 to .050. The 8-32 is also designed with shank of .060 for use in material .050 and greater. The company says the fastener meets torque requirements of AN-N-10 and/or MIL-N-25027 (ASG). Nut and cap are of heat and corrosion resistant steel. —K–3

Engine Mounting Bushing

Raybestos-Manhattan, Inc., announces an engine mounting bushing that is claimed to have longer life than conventional bushings. The new bushing, which has a nonwoven asbestos felt construction, has been approved by manufacturers in the truck and farm equipment field, the firm states. It is designated as U. S. 9526-D1 Pyrotex.

Dimensions of the bushing are 2.972/2.976 in. OD × 2.007/2.012 in. ID × 1.78/1.84 in. long. Applications generally call for two bushings per unit, the company says. —K–4

Boiler Feed Pump

A new turbine type, 1750 rpm, two-stage, center-mounted, boiler feed pump line has been announced by Fred H. Schaub Engineering Co.

According to the company, features of the unit include electrolized impellers with surface hardness of 1100 Brinnell, double row permanently lubricated ball bearings, balanced radial shaft loading, over-strength case, dry-running shaft seals with pressure-relieved boxes.

The design also permits for the first time pulling shaft seals from end of shaft through bearing aperture without dismantling the pump, the company states. The unit is available in capacities to 150 gpm and pressures to 300 psig. —K–5

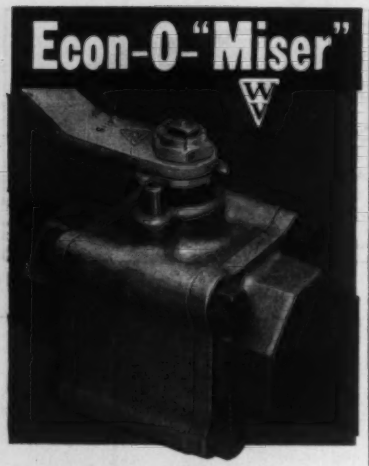
Spindle Nose

A new type of spindle nose in 28 sizes, types and styles for its knee-and-column milling machines has been announced by Cincinnati Milling Machine Co.

The new feature, known as arbor-loc, is designed to provide a quick method of changing arbors. Dimensions and basic design of the milling machine manufacturer's standard spindle nose are retained.

The spindle nose accommodates the firm's new line of No. 50 series standard flanged arbors and adapters. These new arbors can also be used on older machines, the firm states. Special purpose quick change accessories are not required.

The unit can be dismantled within a minute's time when desired to mount face milling cutters on the spindle nose. The conventional draw-in bolt is also supplied for tooling setups which require it. —K–6



Worcester's New Econ-O-"Miser" Ball Valve* is BOTH

VALVE and UNION

The costs of a union and installing it are eliminated. Add to this the longer operating life of the Econ-O-"Miser," the time and materials savings of *in-line maintenance*, and you get performance unmatched by *any* valve at *any* price.

The Econ-O-"Miser" is available in Bronze, Aluminum, Aluminum Bronze, Forged Carbon Steel, types 303 and 316 Stainless Steel. Seat and seal materials available: Teflon, Buna-N and Neoprene (others available on request.)

The many combinations of body and seat seal materials allow handling of exceptionally wide range of media.

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Power Transmission Ball Bearings

Marlin-Rockwell Corp. announces availability of a new series of power transmission ball bearings for conditions involving extremes of dirt and moisture.

The firm states the series accommodates commercially ground inch shafting and may be used in standard pillow blocks. These bearings are prelubricated and equipped with the firm's seals which consist of a metal flinger pressed on the ground outside diameter of the inner ring, forming a close running labyrinth seal with the outboard face of a synthetic rubber element which is snapped into a groove in the bore of the outer ring. The metal flinger is designed to repel dirt and moisture and protect the thin flexible lip of the synthetic rubber portion. —K–7

Inspection Scopes

Kollmorgen Optical Corp. announces its Model TG-2 borescopes, described as slender instruments equipped with integral viewing heads.

The scopes are designed for the internal inspection of small diameter cavities such as rifle and pistol barrels, exhaust tubes, hollow shafts and tubing. Various models are available with minimum bore diameters ranging from .160 to .280 in. and lengths ranging from 5 to 30 in.

The instruments carry their own illumination in a low-voltage lamp in the viewing head. —K–8

Combustion Control Systems

Hays Corp. announces a new line of packaged electric combustion control systems consisting of ten separate standardized systems of control for varying boiler requirements.

The package consists of a completely piped and wired free-standing panel containing all instrumentation and control necessary for fully automatic operation of single burner gas and/or oil fired boilers, the company says. The boilers may be either packaged type or of the field assembled design.

According to the firm, a feature of the system is the placement of the manual-automatic control stations required for operation of the system. The switches, together with indicating lights and push buttons, are located on a small console, 33 in. from the floor, much in the same manner as large central stations. The electrical components cabinet is placed immediately beneath the console and contains the automatic programming control, the fan starter, relays, and terminal strips.

The firm says complete factory piping and wiring requires only that electricity, together with the fuels and steam, be directed through the control panel before reaching the boiler. Control and shutoff valves and pressure switches are included within the piping and wiring of the panel proper. —K–9

Thermocouple Harness

Temperature of exhaust gas from jet engines can be measured by thermocouples which mate to a unique thermocouple harness assembly through a quick disconnect high-temperature thermocouple connector, it is announced by the manufacturer, Airtron, Inc., Linden, N. J.

The thermocouple harness acts as a collector ring, and can handle any number of thermocouples required on the tail cone of the engine, the firm reports.

The assembly is made basically from stainless steel tubing and stainless steel fittings. The tubing, which has stainless steel thermocouple outlets silver-soldered to it, houses alumel and chromel thermocouple wire spaced in ceramic insulators. When the thermocouple harness is installed on the engine and the engine is fired up, an electrical magnetic force is generated and recorded on a millivolt meter. This meter is calibrated to register degrees of Fahrenheit directly.

In operation, the harness must withstand temperatures between 600 and 1000 F, all types of atmospheric and fuel corrosion, and engine shock and vibration. —K–10

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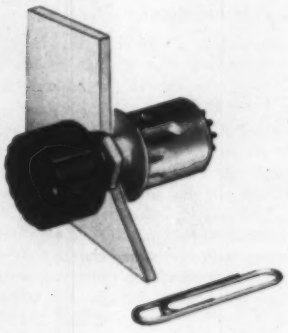


Miniature Switch

A miniature multi-purpose switch for military and commercial equipment is now being marketed by the Components Div., International Telephone and Telegraph Corp., 100 Kingsland Rd., Clifton, N. J.

The switch a ten-position unit mechanically operative through the range of 50 C to 150 C, is rated at 3 amp at 115 v, and withstands vibrations of 5 to 2000 cps.

The switch has hermetically sealed terminals and base and is immersion tested and salt resistant as per Mil Spec. QQM-151a. According to the firm, it lends itself extremely well to explosive proof applications and has an insulation resistance of 100,000 megohms and features hardened ball-bearing detents, molybdenum contacts and solid coined silver contact arms.

Because of its construction, shaft and flange, the switch is universal. It may be ordered to specification with the following type designations; panel mounted MPM-10, panel mounted sealed MPMS-10, flange mounted MFM-10, the flange mounted sealed MFMS-10. The switch is $1^3/_8$ in. long excluding terminals and has an overall diameter of $^3/_8$ in. **—K-11**

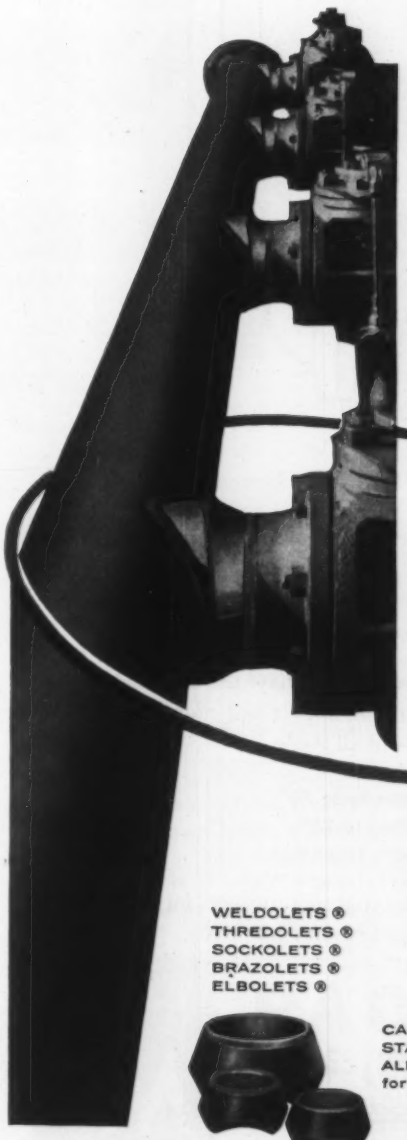
Vacuum Pumping System

A packaged high vacuum pumping system stated to be capable of reaching pressures as low as 5×10^{-7} mm Hg has been announced by Vacuum Equipment Div., New York Air Brake Co.

The system, designated PW-400, is designed for use in the evacuation of such laboratory equipment as vacuum tanks, bell jars, vacuum furnaces, and experimental vacuum tubes. It can be rolled on casters from one location to another.

The pumping system consists of a high-speed, fractionating Kinney 400 F oil diffusion pump with a cold trap and a two-stage, gas-ballasted KC-5 mechanical vacuum pump. Connected to the system is a manifold-valve arrangement with an intake fitting that can be rotated and indexed from horizontal to vertical. **—K-12**

customer reduces estimate of job cost $24,000 by switch to WELDOLETS



An oil piping contract recently was reduced by $24,000 by changing specifications to WELDOLET welding fittings.

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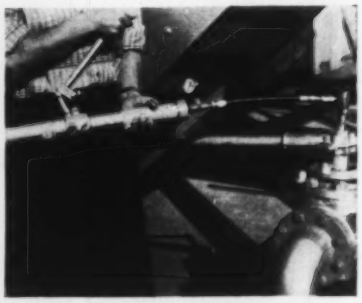
PVC Pipe Fittings

Production of a new line of light weight injection-molded pipe fittings of unplasticized polyvinyl chloride is announced by Tube Turns Plastics, Inc.

The new fittings, the firm says, will match the burst strength of Schedule 40 pvc pipe and will cost about one-third less than the company's regular line of standard heavy wall, Schedule 80, industrial fittings. They will be made of both normal and high-impact materials with the same characteristics of corrosion resistance, non-aging and installation as the heavier fittings, the company states.

The new line includes 90- and 45-deg elbows, tees, couplings, and caps in ¾ to 2 in. sizes, as well as 3 and 4 in. couplings. The fittings are of the socket type, and come in both Schedule A and Schedule 40 wall thicknesses, and match standard pipe sizes that meet ASA and ASTM standards. **—K-13**



Valve Lubrication Handgun

A high-pressure hydraulic handgun specially designed for plug valve lubrication is announced by Rockwell Mfg. Co.

The unit, 400-C, is described as self-priming and can be used in any position. The company says the hose and coupler can be locked to the buttonhead fitting in the valve shank. Pressure may be relieved by a turn of the by-pass valve on the gun to permit separation of the buttonhead coupler and fitting.

A relief fitting on the hydraulic system is designed to guard against injury to the gun if the operator continues to pump after the gun is empty. A 15,000-psi gage indicating the point at which sufficient lubricant pressure has been developed in the valve. The gage also indicates valve adjustment and other services required, and has a recalibrator screw to provide corrections in case it is knocked out of adjustment by rough handling. **—K-14**

For Consulting Engineers Turn to Page 240

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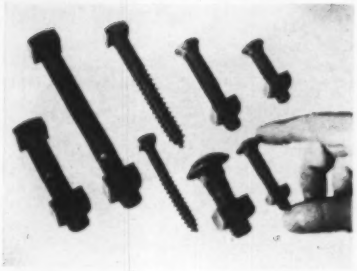


Standard Bolts

Standard bolts in a full range of sizes are now available from the Cleveland Cap Screw Co.

The new line consists of square head machine bolts, carriage bolts, lag bolts and plow bolts.

The company's standard bolts are made of low carbon steel, but can be furnished in high carbon and alloy steels to order. Departures from standard dimensions and types also can be supplied on special order.

The bolts are available in case, full truck and carload lot quantities.

The line includes standard bolts, hexagon head cap and set screws, socket screw products, self-locking screws and special headed and threaded products made to custom specifications in diameters ranging from $^{3}/_{16}$ through $2^{1}/_{2}$ in. —K-15

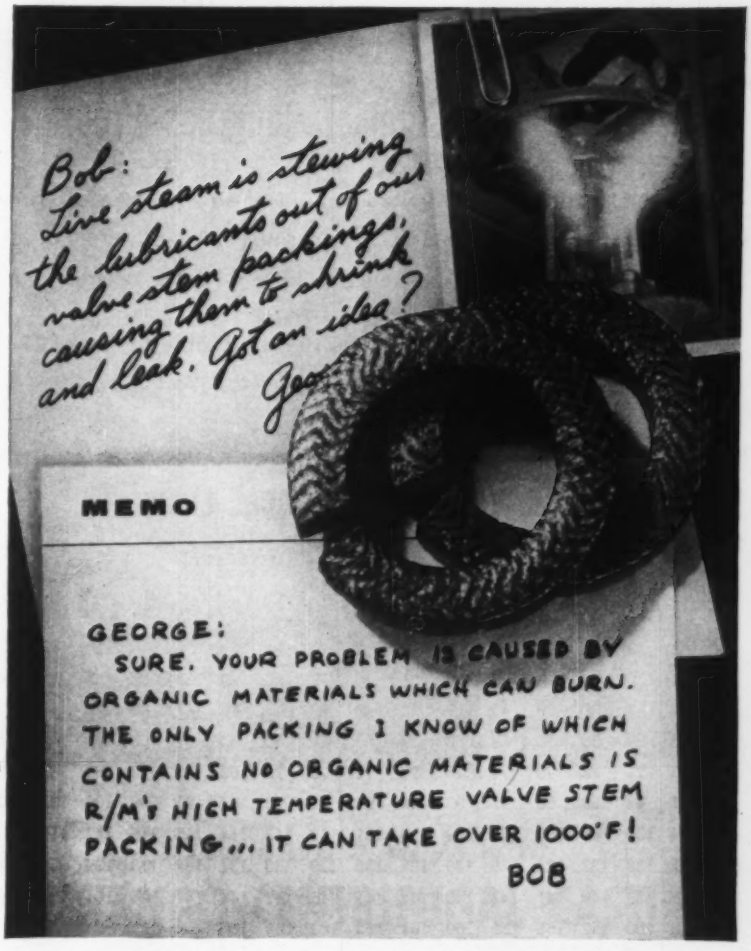
Foil-Type Strain Gages

New SR-4 foil type rosette strain gages said to have substantially higher sensitivity and stability than any previous rosette gage have been announced by Electronics and Instrumentation Div., Waltham, Mass., Baldwin-Lima-Hamilton Corp.

The gages are of bonded filament type construction. The company reports the new rosettes have a sensitivity that is eight per cent higher than that of any previous rosettes. They need no lateral corrections except in the most precise testing problems, can withstand temperatures as high as 300 F in continuous service and are thinner, more flexible and more easily applied than bonded wire SR-4 strain gages.

Two sizes of bakelite bonded rosettes are available: Types FABR-2 and FABR-4, with gage lengths of $^{1}/_{2}$-in. and $^{1}/_{4}$-in. respectively. FABR-2 replaces the epoxy-backed rosette Type FAR-2, the foil gage formerly offered. FABR-4 is an entirely new product.

The bonded-wire type rosette gages most nearly comparable to the new foil gages are the paper-and-cement Types AR-1 and AR-7. The new foil rosettes are superior in dimensions and in many other respects to the AR-1 and so greatly superior to the AR-7 that the foil gage will probably supplant the wire gage entirely, the company says. —K-16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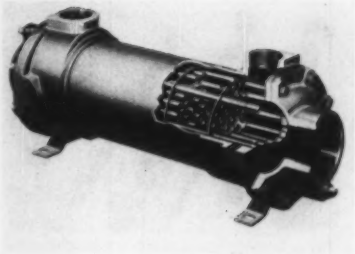

Redesigned Exchangers

An expanded line of Type BCF exchangers, said to have improved performance, new design features, and new materials, is available at lower prices, according to Ross Heat Exchanger Div. American-Standard.

The unit is offered in 46 sizes; one, two, and four pass designes; and 1.2 to 124 sq ft of heat transfer surface.

The firm says improvements include new baffle structure with flanged lip at each tube hole and around outer edge to give tighter tube fit and improved thermal characteristics; stamped steel feet movable in three positions around hubs for mounting; hubs relieved under connections for unrestricted flow; corrosion resistant copper alloy core assembly and cast iron bonnets.

The units are designed for cooling lube oil, jacket water, hydraulic and other fluids, and process heating applications. **—K-17**

Oil Bath Aftercleaner

A redesigned Cycoil oil bath aftercleaner has been introduced by American Air Filter Co., Inc., Louisville 8, Ky.

The new P-17 unit is designed for collecting dust particles that might escape conventional dry centrifugals or viscous impingement filters, the company reports.

The unit is described as an automatic, self-cleaning dust collector that separates dust from the air as it passes through a viscous crimped-wire, fluid bed pad. The dust-laden air is mixed with the oil by means of a perforated plate over which the oil flows from a central distributing point.

According to the company, the upward flow provides the holding force required to keep a large quantity of oil in the fluid bed pad. The fluid bed pad is designed so that collected oil droplets drain to the perimeter which is out of the air stream. This washing action is designed to keep the pad clean and the dirty oil flows back to the settling tank where dust particles settle out as a sludge and the oil is recycled to the unit.

A separate oil reservoir and sludge settling tank is designed to permit easy sludge removal. The collected dust can be removed periodically while the unit is in operation. The settling tank may also be disconnected during the period when the system is not in operation. **—K-18**

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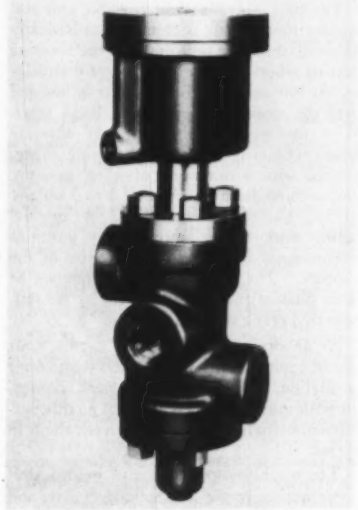
Integral Gearmotors

Western Gear Corp., announces its own line of StraitLine integral and all-motor gearmotors ranging from 1 to 60 hp and from 9 to 520 rpm.

The company states the units are designed for interchangeability of gear sets and motor packages in the field without disconnecting the gearmotor from its foundation or the driven shaft. Changing of ratio in the field when output speed variation requirements arise can be accomplished with the new units, the company reports. Gear housings are accessible from either end. —K–19



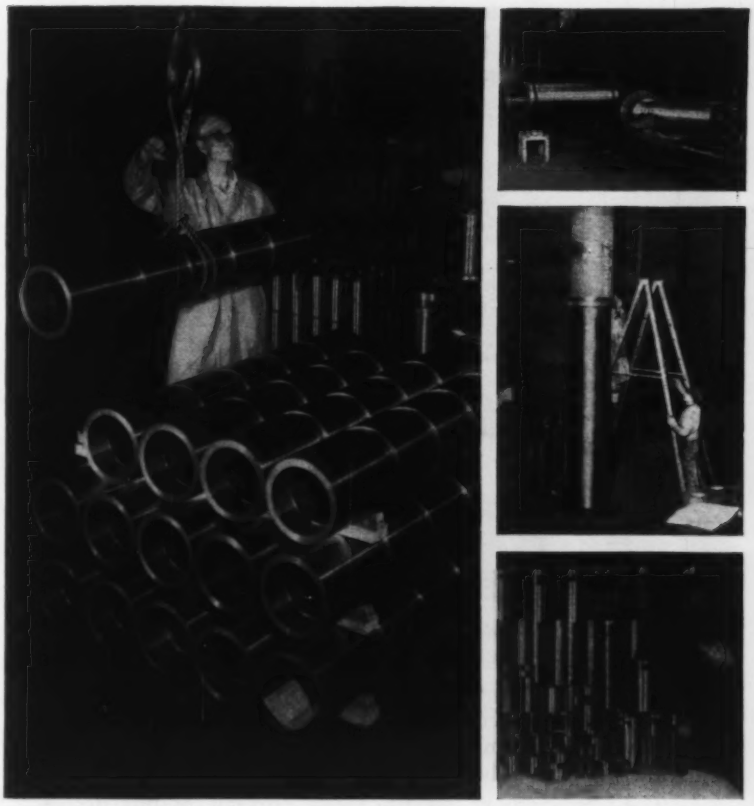
Hydraulic Control Valves

A line of 600 to 4000 psi cylinder operated hydraulic control valves, designed for use where high-speed response, compactness and employment of higher valve operating pressures are desirable, is announced by Sinclair-Collins Valve Co.

Use of an integral double-acting cylinder for valve operation is said to reduce valve mounting space requirements and to afford split-second response due to positive pressure actuation in both directions. Valve operating pressure range is 60 to 140 psi, using air, water, or oil.

Available in 2 or 3-way types, adaptable for either NO or NC operation, depending on piping connections, the new valves are said by the company to be suitable for leak-free control of water, glycol or oil base hydraulic fluids, says the manufacturer. Port sizes of 1, $1^1/_2$, and 2 in. NPT are offered and valves are fitted for remote pilot control.

The valves have Navy M bronze bodies, hardened stainless steel valve stems, replaceable seat sleeves, and Stellite seats. Parts interchangeability is claimed. —K–20



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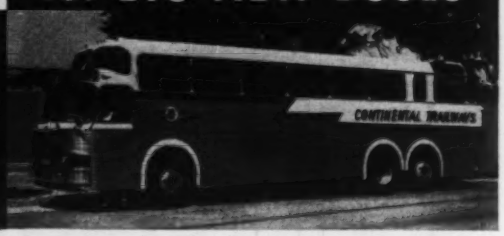

Nugent filters provide positive full flow lube oil filtering for the diesels powering these recent additions to Continental Trailways' luxury bus fleet.

The top photo shows the latest concept in bus design. It's the 60 foot long, articulated *Academy Express,* which takes its name from the new United States Air Force Academy at Colorado Springs, one of its stops on the scenic Pikes Peak Route.

The lower photo illustrates Continental's *Golden Eagle* coach. Nearly 50 buses of this model are now in service with their vast luxury fleet.

Both the *Academy Express* and the *Golden Eagle* offer hostess service, refreshments, rest rooms . . . all the extra touches of first class highway transportation.

Just as Continental's passengers enjoy the ultimate in highway travel luxury, the American-Built Cummins horizontal diesels powering the *Academy Express* buses and the M. A. N. diesels aboard the *Golden Eagles* are provided with the finest in filtering protection . . . NUGENT FILTERS.

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Oscillating Dry-Abrasive Cutter

A dry-abrasive cutting unit designated Model 28 Sever-All, for high capacity for a range of materials, has been announced by Allison-Campbell Div., American Chain & Cable Co.

The unit is equipped with a heavy-duty 10 hp, 3600 rpm motor to provide a spindle speed of 2450 rpm., and is said to have the capacity to handle solid steels up to 4 in. square, 6 in. angles, 8 in. channels, and 4 in. OD pipe or tubing at 90 deg to axis.

The unit is said to provide, with a minimum burr, high quality cutting of practically all metals including hardened or annealed steels, brass, bronze, monel, aluminum.

The unit is available in portable and stationary models. It is described as basically an oscillating type unit in which the abrasive cutting wheel and work pieces are manually fed by the operator. The wheel is lowered into the work by means of a hand lever. With oscillation, the amount of abrasive wheel contact is reduced and cutting is performed with a minimum of wheel pressure and without burn at a rate of 2 to 5 sec per sq in., the company reports. A double-acting work holder automatically positions the material being cut in the center of the support. The material is then clamped at both sides of the abrasive wheel by a hand-operated crank or a foot treadle.

As an optional feature, the cutting unit can be equipped with power wheel feed, power oscillation, and air-operated work clamps. In both units, swing-away wheel guards permit unobstructed access to the vise, the firm states.

The machine's pedestal is of welded steel construction, its top is of solid steel plate and is reinforced under the swing arm bracket. Front and sides of the unit are enclosed by removable steel plates. Its spindle, of forged alloy steel, is heat-treated, precision ground, and dynamically balanced. Each end of the spindle housing has labyrinth sealed type caps to prevent entrance of foreign matter and retain the lubricant. —K-21

Electronic Balancer

A light-weight, low-cost precision electronic industrial balancer, with weight and size ranges for specific use in automobile and truck engine rebuilding, plant maintenance, quality control, and short-run production lines, is announced by Alemite Div., Stewart-Warner Corp.

The company says the unit, called Model 702, is capable of balancing to .004 in. oz, all rotating parts weighing between $\frac{1}{4}$ and 300 lb, with diametral range of from $\frac{1}{4}$ to 30 in. —K-22

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Blast Clean Barrel

Pangborn Corp. has introduced a 72 cu ft Rotoblast barrel to blast clean loads of castings, forgings and heat treated parts weighing up to 6 tons.

The unit is designed for metalworking factories which clean and descale heavy parts in large volume. It is believed by the company to be the world's largest blast barrel manufactured. The firm states that the new unit will clean a 6-ton load of castings in five minutes.

The 72 Type GN barrel is equipped with two Rotoblast wheels, each capable of throwing 120,000 lb of abrasive per hour. Each wheel is powered by a 40 hp motor. Heavy-duty motors power the shaker conveyor, the barrel door and the abrasive elevator.

—K-23

Magnetic Flow Meter

Previously limited to a minimum line size of 1-in., magnetic flow meters, manufactured by The Foxboro Co., are now available for $\frac{1}{2}$-in. flow lines.

According to the company, the meter has over-all accuracy of 1 per cent of full scale throughout the entire scale, no restriction of flow, linear flow readings, and performance unaffected by pressure, viscosity, density, or changes in conductivity of the flowing liquid.

The transmitter unit consists of a Teflon-insulated nonmagnetic flow tube containing flush-mounted metallic electrodes and surrounded by an a-c electromagnet. When a conductive liquid passes through the tube, an alternating voltage is set up between the electrodes which varies linearly in proportion to the volume rate of flow. Lead wires from the electrodes transmit this voltage output to the firm's Dynalog recorder, producing a chart record in appropriate units of flow. Flow rates as low as 3 gpm can be measured by the instrument, the firm reports. **—K-24**

Parts Feeders

New high-speed equipment for automatic high-lift elevating of parts in automated production lines has been developed by the Gear-O-Mation Div., Michigan Tool Co., 7173 E. McNichols Rd., Detroit 12, Mich.

The company reports that the unit also face-orients parts and feeds them into distribution systems at a rate of about 3600 parts per hour. The equipment is described as a combination feeding unit that will handle any part that rolls or slides, such as gears, cylinders, spiders and blanks. The parts feeders are custom-tailored to a specific installation but assembled from standard components.

In operation, parts are fed (from conveyor, truck, tote box) into the hopper-bin section of the unit. From this hopper they are self loaded onto angled retaining rails for elevating and feeding. The hopper is constructed to be self emptying. **—K-25**

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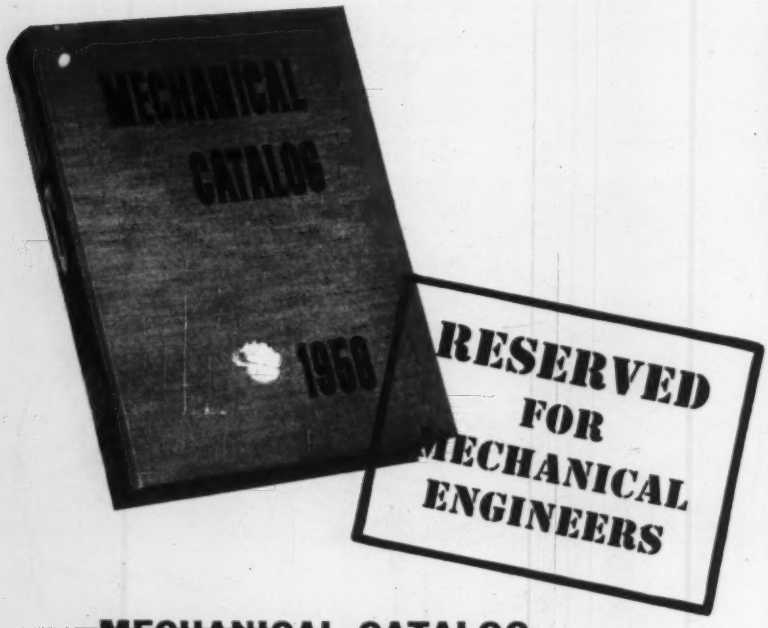

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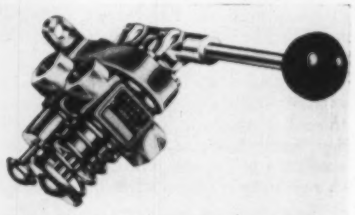
Rubber Vibration Mountings

Lord Mfg. Co., 1635 W. 12 St., Erie, Pa. announces that its bonded rubber vibration and shock control mountings can now be produced to operate efficiently from −65 to +300 F.

These mountings, utilizing the firm's new broad temperature range elastomer, have the ability to withstand temperature extremes with minimum changes in physical properties, the company claims. Transmissibility at resonance is three or less at 68 F; at +300 F it is less than 3.5, it is reported. The elastomer is said to be resistant to oil and ozone, and have high tensile strength, high tear resistance and good flex life.

The hysteresis characteristic of the material eliminates the need for auxiliary dampers that generate harmonics destructive to mounted equipment, the firm states. **—K-26**



Tandem-Mounted Control Valves

A line of lever-actuated tandem-mounted 3-and 4-way control valves with neutral position designed for up to 250 psi pneumatic, 325 psi oil or vacuum service, is announced by Valvair Corp.

According to the company, typical 4-way valve applications include simultaneous operation of a pair of single-acting cylinders or positive control of a double-acting cylinder, by using different combinations of 3-way valves in pairs. Either manual or spring-actuated neutral positioning is available. The tandem valve is interlocked to prevent both valves from operating at the same time, the firm reports.

One-piece Navy M bronze body and hard chrome-plated stainless steel stem are used in the company's straight-through construction designed to simplify maintenance and allow drop-in replacement of packers, the manufacturer states. Molded Hycar OU packers, reputed to be unaffected by water, grease, air, or oil, are used in valves for pneumatic service. For hydraulic or vacuum use, heat and hydraulic fluid-resistant moly-compounded O-ring packers are furnished. According to the manufacturer, flow area through the valves is equal to nominal pipe size.

Available with open end or piped exhaust, the valves are offered in port sizes from 1/4 through 1 in. NPT, in both 3-way and 4-way with neutral types. **—K-27**

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Temperature Indicating Controller

Temperature indicating controllers, Series 541, are now available from Fenwal, Inc., with explosion proofing to conform to Underwriters' Laboratories categories Class I, Groups C and D; and Class II, Groups E, F, and G.

The company says this modification enables use of the instrument in hazardous locations with no special precautions. The box mounted atop the standard control case contains the electrical snapswitch to enable the standard unit to be modified.

Normally, the firm says, the explosion-proof controller will have one SPDT switch and two dial pointers; one to indicate set point, and the other for process temperature. Set point can be adjusted with the large control knob on the front of the housing. Other features of the series include swivel-mounted and stainless steel capillaries, simplified internal construction and a choice of housing colors.

Temperature ranges extend from −150 to 700 F, with C scales on request. Bulb sizes are 1/4, 3/8, and 1/8 in. coiled to 3/4 in. OD; capillaries are 6 and 10 ft with special lengths up to 20 ft. All are made of corrosion resistant type 316 stainless steel. **—K-28**

Box Car Unloader

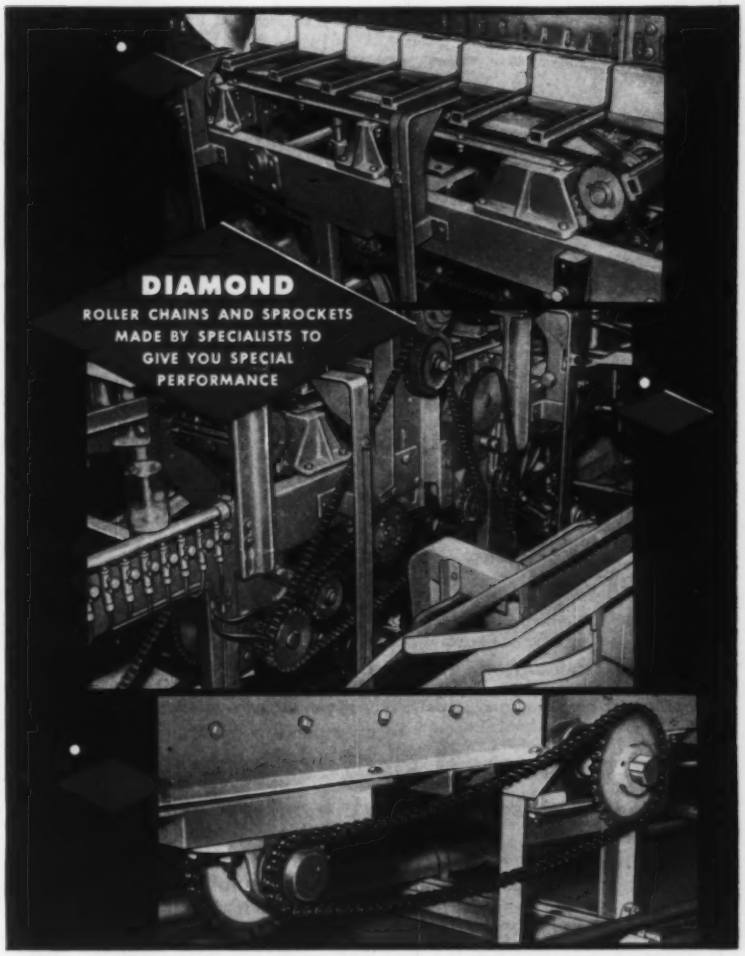
A redesigned hydraulically-operated box car unloader is announced by Stephens-Adamson Mfg. Co.

According to the company, the unloader has proven during on-the-job performance that it can unload granular, pulverized, or any free-flowing materials from the largest box cars in less than 30 min per car. In comparison with rotary or tilting car dumps, original and operating costs for the new device are low, the firm states.

The unloader can be operated by one man, the companys says. Boom swivel and scoop actions are hydraulically actuated and can be operated automatically during much of the unloading cycle. The firm points out that this feature leaves the operator periodically free to dispose of grain doors, prepare other cars for unloading, or ready a car puller to move the unloaded car away and get a loaded box car in position.

In the unloading operation, the boom and scoop are swung into the loaded box car. When set in motion, the scoop is in a raised position and the boom extends until the scoop meets resistance in the form of material or the car wall. This resistance causes the scoop to dig down into the material. The boom retracts and pulls the loaded scoop to the open car door for discharge. After discharging, the scoop rises automatically, and the boom extends again to repeat the cycle.

The operator can stop the cycle at any time to redirect or to withdraw the boom and scoop from the car, company says. **—K-29**



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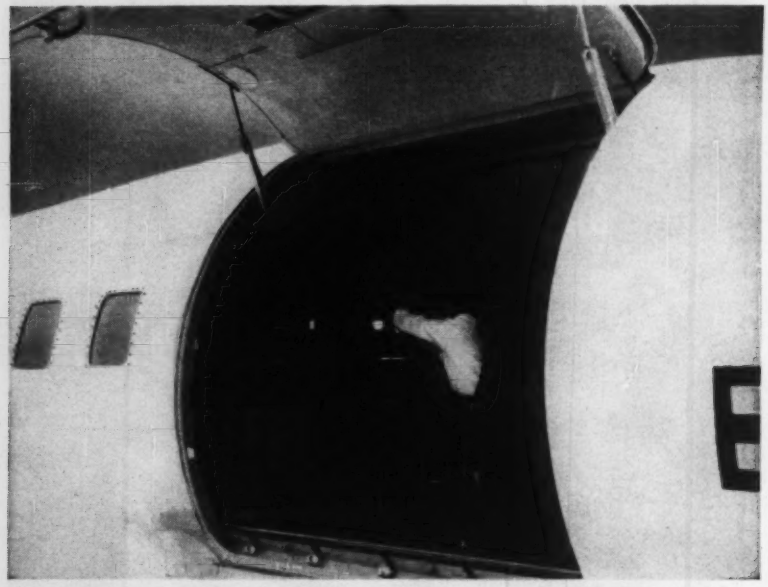

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Pancake Motor

Louis Allis Co. announces a pancake motor said to reduce motor length up to 60 per cent over standard motors of the same rating. It is designed for use on machine tools, roof-ventilating fans and space-cramped applications.

The motor is a flange type motor of conventional radial air-gap design. The company says the short length is achieved, without any reduction in motor performance, through formed end coils and a one-piece housing-bearing bracket.

For normal operating conditions the motor is built in an open drip-proof enclosure. It is also supplied in an enclosed construction.

The motor is available in ratings from 1 to 15 hp at 1800, 1200 and 900 rpm. It is available with either vertical or horizontal mounting, cast iron housing-bearing bracket and factory lubricated bearings. **—K-30**

Special Lift Truck

Yale & Towne Manufacturing Co., 11,000 Roosevelt Blvd., Philadelphia 15, Pa. has developed an industrial lift truck with channels that lower below ground level for special handling jobs.

The company says the truck can be used for such assignments and handling in pits, lowering palletized materials into dipping or cleaning tanks, or transferring material in a varied floor-level plant.

In a 6000-lb. capacity model, the truck can handle loads off a level 72 in. below the floor and raise them to a height of 41 in. above ground level.

The primary lifting channels support secondary lift channels which are attached to a fork carriage at the top of the primary channels. Each channel assembly has its own lifting cylinder and set of controls.

For operations below ground level, the secondary channels with a fork carriage mounted at the bottom of the mast are lowered hydraulically. The overall height of the new unit is 83 in. **—K-31**

Digital Recorder

Hewlett-Packard Co. announces development of Model 560A digital recorder, designed to print 11 column digital information at rates to five prints per second.

It is primarily designed to make a permanent record of electronic counter read-outs, the manufacturer states, adding that the unit can be used with two or more counters simultaneously, digital voltmeters, time recorders, flowmetering equipment and systems for telemetering installations and engine test stands.

In addition to the printed tape record, the unit provides an analog current or voltage output to drive a galvanometer or potentiometer strip chart recorder or to provide a servo control. **—K-32**

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BUSINESS NOTES
NEW EQUIPMENT
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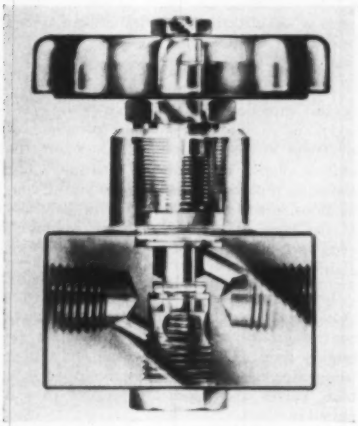
Power Take-Off Compressor

A package unit, designated 125' rotary power take-off compressor, is announced by Worthington Corp., Holyoke, Mass. Div.

The unit includes a two-stage oil-cooled rotary compressor, speed control, engine governor, oil cooler, air receiver, oil separator, and oil storage receiver, all mounted on a common base plate.

The company says the unit can be completely controlled from the cab by the driver. The compressor is belt-driven through a split power take-off. The unit is 38 in. long by 28 in. wide by 39 in. high. Through an infinitely variable capacity control, the rotary power take-off compressor produces more air than conventional reciprocating machines, the firm states. **—K-33**



Manual Shut-Off Valve

A manual shut-off valve, Model 949T, for high pressure gas systems and missile and rocket applications has been announced by Circle Seal Products Co.

The unit is designed with threads above seal out of fluid stream. It is said to feature low operating torque and increased depth of finger detents in handle. The firm states the flow passages and stem length of the unit permit mounting in thick panels. The unit has a 303 stainless barstock body.

According to the company, the valve provides positive, leak-proof shut-off by means of a resilient O-ring which is withdrawn completely and automatically from the fluid stream as soon as the valve begins to open. Throttling is then accomplished by means of a conical metal plug which varies the orifice area. During use for throttling the O-ring is outside the fluid stream and completely caged to prevent washouts. The O-ring is not required to pass a port or other diametral relief or constriction which might inflict damage to its surface, the firm says. **—K34**

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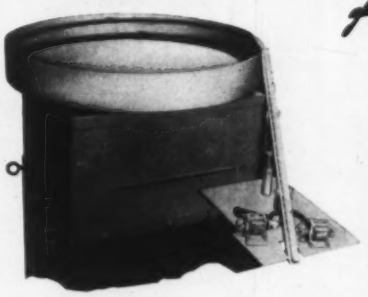

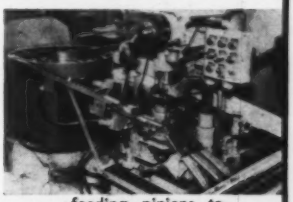

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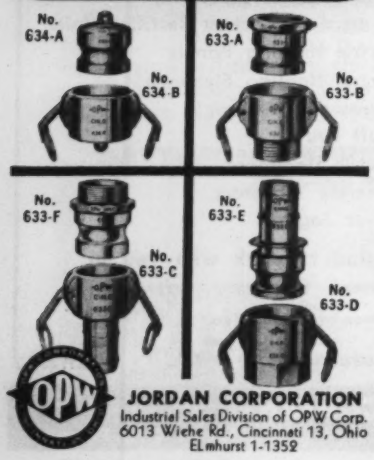

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Chemical Metering Pumps

For metering toxic, obnoxious, corrosive and/or costly chemicals, Milton Roy Co. has introduced a new controlled volume diaphragm pump.

The pumps have Teflon diaphragms sealing the liquid ends from the plunger and housing. They are said to be accurate to within ± 1 per cent. The plunger displaces hydraulic fluid which in turn strokes the diaphragm to impart pumping action through double ball checks. There is no mechanical connection between the diaphragm and the plunger.

They are available with maximum capacities from 1.1 to 138 gph and pressures to 2000 psi. The pumps have manual or automatic capacity adjustments from 0 to 100 per cent. —K-35

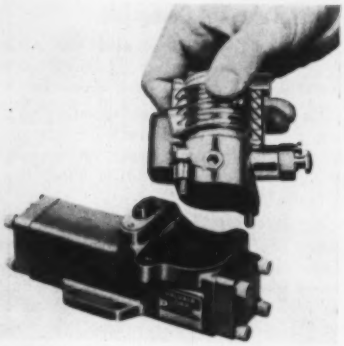
Marking Machine

A new offset marking machine for cylindrical objects where frequent changes in imprint data must be made is announced by Markem Machine Co., Keene 82, N. H.

The Model PAM-AG uses a masterplate and removable type inserts, instead of a rubber printing plate or type lock-up, allowing quick change of imprint variables within the manufacturer's own plant, the firm states.

The bench-mounted unit employs interchangeable work-holding fixtures to handle various cylindrical, tapered, conical, or wire lead objects, $1/8$ to $2\frac{1}{2}$ in. in diam, that cannot be chute fed. These, the company says, include bottles, vials, cans, transistors, capacitors, solenoids and similar electrical components. The unit will mark a maximum imprint area of $3 \times 2\frac{3}{4}$ in. Recommended operating speed is 50 to 60 objects per min, but the rate is adjustable. Ejection of marked objects is automatic.

The marking compounds available include air drying, baking, and high temperature types; special formulations for clear, durable imprints on many surfaces; choice of colors. —K-36



Control Valves

A line of Speed King plug-in type $1/4$ in. 4-way control valves with built-in plug connectors designed for fast automatic connection of electrical circuits is announced by Valvair Corp.

Said to reduce original installation and in-service maintenance time, plugs and connectors incorporated in solenoid pilot, valve body and manifold or sub-base complete all electrical circuits automatically when the unit is placed in mounting position. The company reports that permanent wiring connections, made in the manifold or sub-base at the time of original machine assembly, need not be disturbed during in-service maintenance.

The plug-in feature is said to also permit economical bench assembly of complete control groups and cuts final machine assembly time. Once basic wiring and piping connections are made to manifold or sub-base, valves and pilots are plugged in and bolted in place.

The units are designed for control of smaller devices, and are available in both single and double solenoid types, for manifold or sub-base mounting. —K-37

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Remote Control Switches

Automatic Switch Co. announces that remote control switches are now available equipped with vibration mounts and in soundproof enclosures.

The mechanically held remote contro switches are described as being used to provide accessible control of power and lighting circuits from any number of central stations. Since they are mechanically held, they are unaffected by line voltage conditions and respond only to the control of pushbuttons, the firm states. —K–38

X-Ray Generator

A new Diaflex X-ray generator is announced by Westinghouse Electric Corp. The firm reports the new design provides automatic density compensation so fluctuations in line voltage do not cause variable density films.

With inherent density stabilization the selected ma-sec is held constant regardless of tube current fluctuations. The ma-sec selection–10 to 350–provides ample range for use of any technique under operating load, the company states.

Selection of kilovoltage by the 10-kv steps major selector and the 1-kv steps minor selector is designed to allow any technique to be applied. The technique control for radiographic work is calibrated in terms of desired results. The firm states that for techniques requiring other than routine settings, any one of the three positions may be selected. When the technique control is in the fluoroscopic position a separate control of 1 to 6 ma is allowed and is indicated on the fluoroscopic ma meter.

The self-rectified transformer provides 100-ma full wave at 85 kv, and 200-ma full wave at 100 kv with 2 or 4 outlets. —K–39

Powder-Actuated Tool

A powder-actuated fastening tool, designed to stop an overdriven fastener and eliminate danger of firing through a thin work surface, has been introduced by Ramset Fastening System, a subsidiary of Olin Mathieson Chemical Corp.

The tool is called Flite-Chek. Control is accomplished by a new assembly whose tapered interceptor jaws prevent the passage of an overpowered fastener or one that encounters a soft or thin spot in the work surface, the company reports. The fastener is stopped before it leaves the tool. When the fastener is stopped in this manner, the operator pulls the tool off the work, and there is no damage to the tool, the firm states.

According to the company the tool is capable of sinking a fastener into as much as an inch of steel. —K–40

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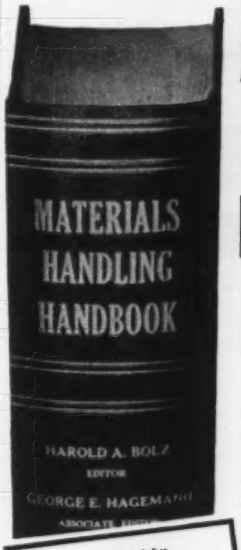

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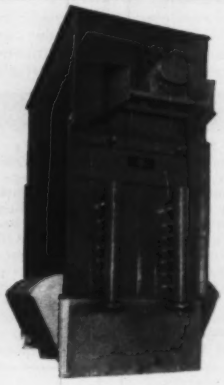

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Indicating Potentiometers

An indicating version of its Dynamaster self-balancing electronic potentiometer or bridge has been announced by Bristol Co.

The indicator is designed for use when legibility of the indicating scale from greater distances is an important factor, the firm explains. The instrument has a 32-in. long scale and the same pointer as the firm's standard round-chart recording unit, and is mounted in a standard case. There is no recording mechanism, however, and the new instrument indicates only, the company says.

The instrument is also offered in electric control models, in on-off, two-position, three-position, floating, proportional, and current-input types of control. The firm says the new instrument can be used for measurements of such variables as temperature, speed, pressure, smoke density, pH, and electrical values. **—K–41**

Load, Unload Unit

A new automatic loading and unloading device which can be used to automate standard grinders in transferring work to and from each grinder is announced by Wickes Corp. Machine Tool Div., Saginaw, Mich.

The transfer unit includes its own hydraulic and electrical equipment, and is tied into a grinder by a terminal for synchronized operation. The unit is built in capacities to meet requirements of each application. In one application, it handles two 75-lb automotive crankshafts simultaneously, the company reports.

The unit is designed to straddle the grinder being serviced, with a loading and unloading station at each side. The firm points out that it can be tied in to service, on an alternate basis, two automatic conveyor lines, one on each side of the grinder.

In operation, each loading station, lowers to pick up the work, raises and transfers the work across and down into the grinding work area. Cycle time is about 15 sec. **—K–42**

Magnetic Rolls

Eriez Mfg. Co. has announced a line of nonelectric magnetic flat-face rolls for magnetic belt and roller conveyor systems.

They are called Magna-Rolls and are being produced in sizes from $2^1/_2$ through 30 in. diam, each with the magnetic strength and depth of field required for given applications.

The new rolls are designed for use as head pulleys or tail pulleys, for holding, controlling, or elevating ferrous parts, receptacles, boxed metal pieces, rods, bars, pipes, and steel sheets. **—K–43**

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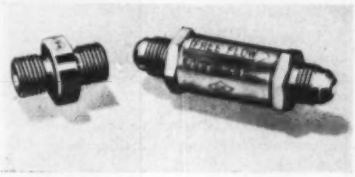

Miniature Check Valves

Republic Mfg. Co. has designed a line of miniature check valves, called Mini-Valves, that are said to be no wider and only slightly longer than unions of the same tube size.

The photo shows the Size 6 valve compared with the size 6 conventional high pressure check valve. Both units operate on pressures up to 5000 psi. Although made of stainless steel, the weight of the new valve is less than the usual aluminum check valve having the same tube size, the company reports.

The valves are approximately one fourth the size of the regular check valve, yet the rated flow is equal, and pressure drop characteristics meet or exceed MIL-V-25675, the firm states.

According to the company, the valves can be used with any medium compatible with 18-8 and hardened 440F stainless steels over a temperature range −65 to 400 F. The line is made in tube sizes 4 to 16 ($^1/_4$ to 1 in.), and has MS33514 flareless tube connections as standard. —K–44

Nitrile Rubber

Development of what is said to be the first nitrile rubber to resist ozone cracking has been announced by B. F. Goodrich Chemical Co.

According to the firm, compounds of Hycar 1072 nitrile rubber can be made which are unaffected by ozone during an extended test period, even when the compounds are soaked in hot oil before exposure to ozone.

The compound, after immersion in ASTM No. 1 oil for 70 hr at 212 F, showed excellent resistance to ozone exposure, the company reports, and a compound containing an added anti-ozonant showed excellent resistance to ozone both before and after immersion in hot oil. —K–45

Hydraulic Presses

Perry Co., Waco, Tex., announces a new line of all steel hydraulic presses to be marketed under the trade name of Longhorn.

Standard presses are being produced from 160 to 1500 ton capacity. Special presses, designed to customer specifications and capacities, are also available.

The presses are designed to handle al metal forming operations, and for trimming and punching vacuum formed plastics as well as other materials, the firm reports. All units are equipped with NEMA 12 or JIC standard electrical circuits. —K–46

6000 cps

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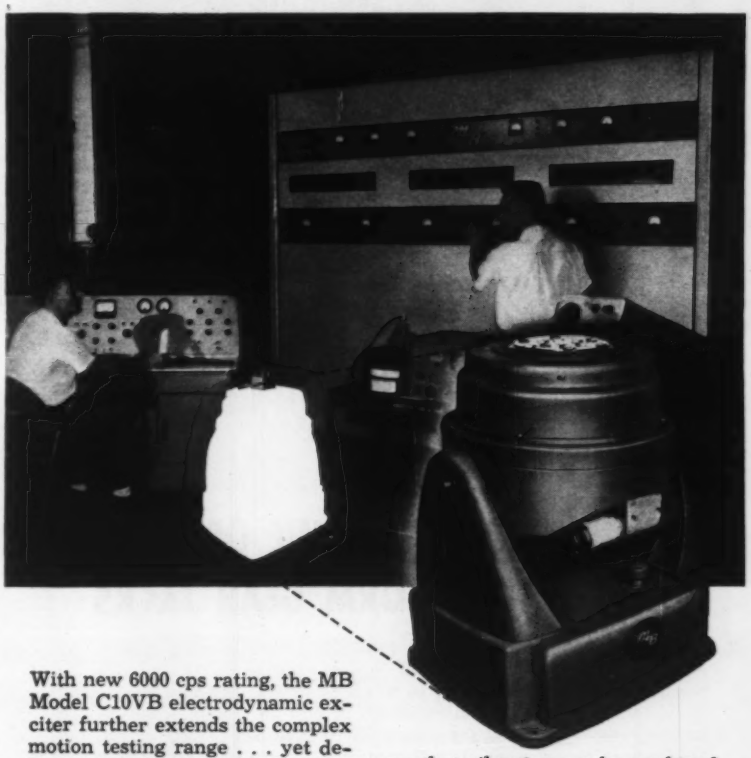

With new 6000 cps rating, the MB Model C10VB electrodynamic exciter further extends the complex motion testing range . . . yet delivers 1750 pounds force for sinusoidal testing with an MB Model T666 15 KVA amplifier (36,000 watt plate dissipation).

This is versatile equipment. With an MB T666 amplifier and TEMC control cabinet, it has the "muscle" to subject electronic products and other critical components to accelerations up to 58 "g". Adding an MB T88 Complex Motion Console equips it for duplicating the actual "noise" or random motion of the environment. This system is designed with an eye to future needs.

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HEADQUARTERS FOR PRODUCTS TO ISOLATE . . . EXCITE . . . AND MEASURE VIBRATION

NOW, A STANDARD LINE OF DUFF-NORTON WORM GEAR JACKS

The economies of standardized production now can be realized by machinery designers who use Duff-Norton worm gear jacks for accurate positioning of loads weighing as much as several hundred tons. After 25 years of experience and hundreds of custom designs, Duff-Norton engineers have produced a standard line of eight jacks ranging from 2 to 100 tons in capacity which will meet almost any requirements. When jacks are used in an arrangement, added economy can be realized in raising unevenly distributed loads, since all models now have a uniform raise which permits jacks of varying capacities to operate in unison.

Worm gear jacks are purely mechanical devices, and they can hold heavy loads in position indefinitely without any creep. Functioning as components of machinery or equipment, they can raise or lower loads, apply pressure or resist impact. Worm gear jacks can be furnished with raises up to 24 inches, and they will provide exactly the same raise for years without adjustment.

Thousands of these jacks are in use on feeding tables, tube mills, welding positioners, pipe cut-off and threading machines, testing equipment, aircraft jigs, loading platforms, rolling mills, conveyor lines, and numerous other types of equipment. If you have a positioning problem, write for complete information, requesting Bulletin AD-66-FF, which includes drawings and full specifications.

See Worm Gear Jacks at Booth 918, Design Engineering Show

DUFF-NORTON COMPANY

P. O. Box 1889 • Pittsburgh 30, Pennsylvania

COFFING HOIST DIVISION • Danville, Illinois

DUFF-NORTON JACKS
Ratchet, Screw,
Hydraulic, Worm Gear

DUFF-NORTON

COFFING HOISTS
Ratchet Lever
Spur Gear, Electric

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Static Seal Valves

Skinner Seal Co., has announced the production and availability of a new line of valves which incorporates its line of static seals.

The valves are designed to handle extreme temperatures involving fuels, oils, gasses, and other fluids and liquids. **—K–47**

Magnetic Conveyor

A line of conveyor units utilizing permanent magnetic equipment has been announced by the Bosworth Mfg. Co., Mills Rd., Avon, Ohio.

According to the company, nylon guides ride in a track in the conveyor bedplate keeping the belt permanently aligned without fatigue. The unit is said to be adaptable as part of an automatic production line or to speed work on individual machines, handling, stampings, machined parts, scrap, nuts, bolts, caps.

The firm says the unit is capable of elevating to 90 deg, and occupies little floor space. No side rails are necessary because of the magnetic bed, so objects wider than the conveyor can be moved without spillage, it is reported. Magnets are permanent, non-electric type, strength engineered to the individual job requirements. The unit utilizes sealed, selfaligning ball bearings. **—K–48**

Micronic Filtration

Industrial Filtration Co., Dept. FMH-200, Lebanon, Ind., announces that its Del-park tubular screen vacuum filter has been increased in capacity to handle flow rates to 1000 gpm on water.

It is designed specifically for the filtration of grinding coolants and cutting oils, the firm says, and the unit, called Filter-Matic, makes micro-inch finishes more easily attainable.

Filtration is accomplished by tubular screen elements manifolded into a suction header box in which a vacuum equivalent to 18 in. mercury is maintained. Automatic, self-cleaning is accomplished by a float activated micro-switch which energizes an air valve and cylinder and reverses the coolant flow through the manifold into the tubes knocking off the filtered deposits held on the periphery of the tubular screens, the company explains.

The sediment from the screens is removed by chain-driven flights which deposit the sludge in a tote box for disposal. The flow of coolant to or from the filter is not interrupted during the cleaning cycle, the company reports.

Filter-aids may be used for pre-coating the screens when absolute filtration is required. An automatic pre-coat feeder is supplied as optional equipment. Multiple units are used for recommended capacities over 1000 gpm. Smaller units available from 5 gpm. **—K–49**

up-rate horsepower

Houdaille torsional vibration damper

Untuned damper
Simple design
Longer life
Extensively tested
Completely proved
Widely adapted

Don't let torsionals restrict your engine design! Get the horsepower you want . . . without increasing engine size or crankshaft redesign. Use Houdaille Viscous Rotary Dampers. These compact *untuned* dampers offer the only truly effective way of minimizing torsional vibration across the *full range* of engine criticals.

The shearing action of highly viscous fluid, used exclusively makes it unequalled in performance.

Precision design assures long, trouble-free life. There are no rubber parts to deteriorate from heat or grease.

Typical applications include: Hydraulic servo loop system stabilization. Rotational transient stabilization. Crankshaft and camshaft torsional vibration damping.

Now available in a wide range of sizes from 1½" to 34" in diameter . . . to meet every requirement. Houdaille engineers are at your service in solving vibration damping problem.

Range of Damper Specifications:

O.D. Inches	THICKNESS Inches	FLYWHEEL INERTIA Lb. In. Sec.²	HOUSING INERTIA Lb. In. Sec.²	DAMPING CONSTANT In. Lb./ Rad./Sec.
1.625	0.750	.00023	.00003	.002
34.031	5.875	330.000	138.000	58,000

FREE TECHNICAL BULLETIN gives complete engineering and performance data. For your copy write:

Specialists in vibration control and hydraulic applications

Houdaille Industries inc.

BUFFALO HYDRAULICS DIV. • 537 E. Delavan Ave., Buffalo 11, N. Y.

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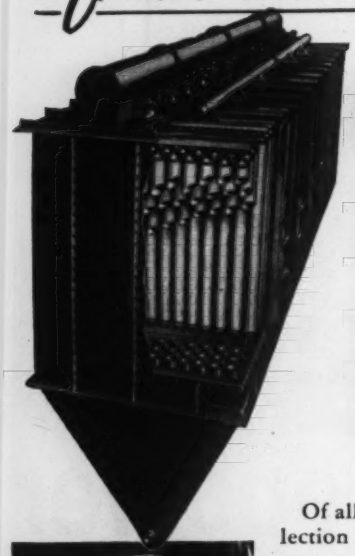

Norblo

Automatic Dust and Fume Collection delivers dependable heavy duty service at low cost

Of all the major types of dust and fume collection systems, the modern automatic bag type process as developed by The Northern Blower Company is the most widely useful and adaptable. Its use in important large scale production processes extends from coast to coast, and to foreign lands.

Norblo's experience in the removal of injurious or "nuisance" industrial air contaminants as well as salvaging valuable materials has been extensive in most industries. Complete systems are engineered to specific situations. Equipment can be supplied for intermittent use or for 'round-the-clock full capacity requirements. Fully coordinated functional design results in high efficiency, low cost of operation and maintenance.

Norblo engineers the complete installation with ample capacity for your needs, with wide adjustability and all the safeguards you may need. It will pay you to have Norblo engineers study your requirements. Write for Bulletin 164.

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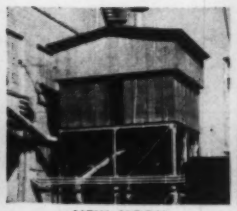
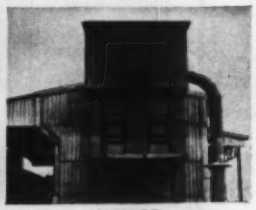


NEW YORK



MEXICO

Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Stainless Gate Valves

A line of 600 lb series stainless steel gate valves, designed to meet API 600 and ASA B 16.5 specifications, is available from Cooper Alloy Corp.

The valves, produced in sizes ½ to 2 in. screwed and socket weld and ½ to 8 in. flanged and butt weld, have a pressure range of vacuum to 1440 psi and a temperature range of −425 to 1500 F with proper packing. Valves operate at rated pressure at temperatures to 1125 F.

The firm says new features of valves include large diameter handwheel, deep stuffing box, lantern rings, back seat bushings, and 2-piece packing follower and flange. Three-in. sizes and larger are available with removable yoke nut, and 6-in. valves and over with roller thrust bearings. Flexible disks are available in the larger sizes. —K-50

Gear-Case Exhauster

A & A Mfg. Co., 712 S. 12th St., Milwaukee 4, Wis., announces a newly developed gear-case exhauster designed to draw a partial vacuum in the gear case and thereby substitute air flow into the case in place of oil leaking out of it.

According to the company, the exhauster can be applied to a variety of gear cases by removing the conventional inspection plate and bolting in the exhauster. The vacuum air pump is driven through a flexible coupling by a ¼ hp motor.

Filter tank, mounted between the gear case and pump intake, serves to remove the oil from the evacuated air before the dried air enters the rotary pump. Oil, under gravity, flows back into the gear case without piping, the firm explains.

The pump maintains a vacuum of 3 to 5 in. mercury depending on the amount of leakage that may exist around the gaskets and oil seals. —K-51

Adhesive for Teflon

Flexrock Co., 3600-C-Filbert St., Philadelphia, Pa., is now offering an adhesive for binding Teflon to Teflon, or Teflon to metal and a variety of other materials.

The newly developed adhesive is of the pressure sensitive type, and tests indicate a peel strength of over a thousand grams per inch or a direct pull of 12 to 15 psi for Teflon to Teflon, and Teflon to stainless steel.

It is also reported that the adhesive has good acid and alkali resistance, and excellent electrical properties. It can be applied by brushing, dipping or spraying. After applying the adhesive to the Teflon, it should be dried before pressing the parts together. Air drying is satisfactory but takes several hours which can be reduced by heating for 15 to 30 min at about 210 F. Heating for 5 min at 300 F will result in greater adhesive strength, the firm says. —K-52

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Totally-Protected Motors

A line of totally-protected, Series D, a-c motors in the new, large NEMA frame 364U through 445U is now being introduced by Reliance Electric and Engineering Co., 24701 Euclid Ave., Cleveland 17, Ohio.

Foot-mounted and footless horizontal models in the 360 frame diameter are presently stocked in the following enclosures: protected, totally-enclosed, fan-cooled; corrosion-proof; and explosion-proof. They are designed for operation on 208 through 550-v in-plant alternating current. Other new NEMA frame sizes through 125 hp, with their modifications, are being made available on a monthly schedule, the company reports.

In NEMA electrical design B, design C, and design D, the new line of large-frame motors may be specified in many speeds with Class A, B, or high-temperature H insulation. The firm says part-winding starting, to eliminate loading of power supply lines and resultant momentary light dimming, is available for commercial air-conditioning and other applications with similar requirements. **—K-53**

Test Oscillator

A portable, pushbutton test oscillator, featuring all-transistor circuitry, printed wiring and self-contained power supply, is available from Alectra Div. Consolidated Electrodynamics Corp., 325 N. Altadena Dr., Pasadena, Calif.

Designated Model 21A, the new instrument is designed specifically to expedite repetitive-type operations such as are encountered in laboratory, production, and maintenance applications. It provides 8 preset frequences, user-specified, within the range of 15 cycles to 150 kilocycles at a source impedance of less than 0.5 ohm.

Normal warm-up period required by vacuum-tube equipment is eliminated. The absence of drift caused by vacuum tube warm-up assures stable readings as soon as the instrument is turned on, the firm says.

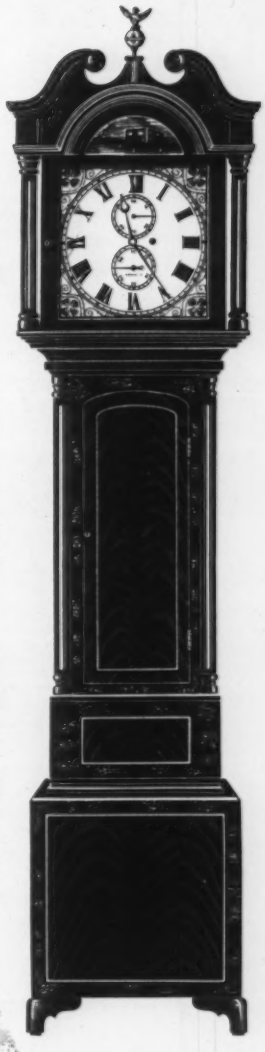
The instrument's self-contained power supply consists of six four-v mercury cells which provide complete independence from line power. The instrument weighs $6\frac{1}{2}$ lb and measures $6 \times 8 \times 6$ in. **—K-54**

Aluminum Valves

Gate valves of aluminum alloy are now being offered for general application by Darling Valve & Mfg. Co., Williamsport, Pa.

According to the firm, the valves currently available range from $\frac{1}{2}$ to 24-in. sizes and include types for every requirement where aluminum piping systems are now being used or planned. The valves incorporate the principle of fully revolving double disk parallel seat gate valve operation. **—K-55**

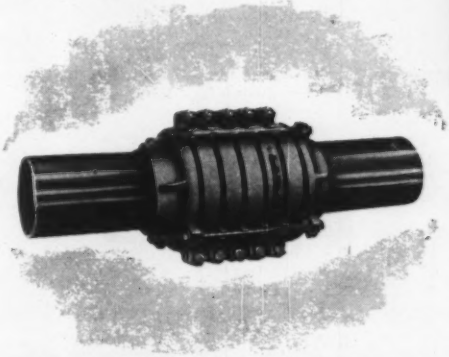
19,862 years of precision metal-forming



When you specify FLEXON® Expansion Joints, you actually *buy time*—19,862 years of combined experience in the team of engineers, metallurgists, and technicians who produce Flexon Expansion Joints!

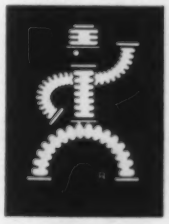
And all this time has been invested in perfecting formed and corrugated tubular shapes in metal, made with watch-like precision—flexible metal hose, instrument-type bellows, "impossible" bends and section modulations for aircraft parts . . . **and expansion joints of every kind.**

So—for expansion joints that you can *install and forget*—always specify FLEXON. Free-flexing and controlled-flexing; dual and multiple types; balanced joints and other special designs; all in stainless steel, monel, and other workable alloys. Assured longer service life, through careful analysis of your application plus unmatched skill in manufacture.



Write today for your copy of the Flexon Expansion Joint Design Guide—28 pages of facts about absorbing pipe motion.

EJ-210

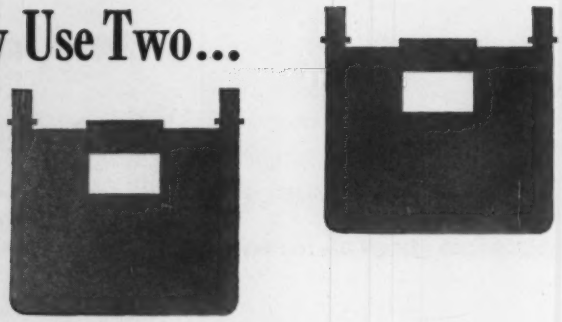


Flexonics corporation

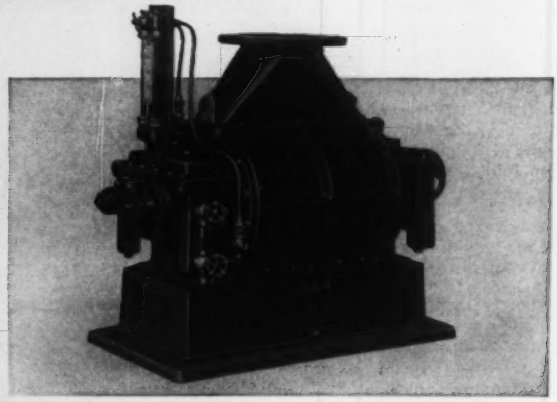
EXPANSION JOINT DIVISION—1305 S. THIRD AVE., MAYWOOD, ILL.

EXPANSION JOINTS · METAL HOSE · NON-METALLIC HOSE · BELLOWS · AIRCRAFT COMPONENTS

Why Use Two...



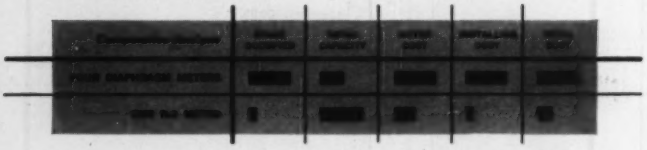
When One Will Do...



Better!

When *one* Roots-Connersville rotary gas meter is used in place of *two* . . . or *three* . . . or *four* of other types, metering costs go down.

This fact has been proved by utility companies and commercial and industrial users of gas everywhere as shown in this typical comparison:



First cost is substantially reduced with the proper selection of the *one* Roots-Connersville meter, from the 39 sizes offered, for a specific requirement. Further savings are made in foundation, piping and installing costs, and in space.

But this is only part of the story. Roots-Connersville gas meters assure unalterable accuracy with far less maintenance than required by other types. There are no valves, valve gear or other small parts to wear out and cause inaccuracies. Servicing is limited to lubrication of bearings and gears and an occasional check of the operating differential.

For additional data, please refer to our section in Chemical Engineering Catalog or Mechanical Catalog or write for descriptive Bulletin M-152.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

358 Michigan Avenue, Connersville, Indiana. In Canada — 629 Adelaide St., W., Toronto, Ont.

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Double-Acting Cylinders

A line of 2000 psi double-acting hydraulic cylinders with interchangeable foot lug, center lug, front flange, rear flange, and clevis mounting steel end heads is available from Oilgear Co. The cylinders are built in eight sizes from 2 to 8 in., with standard or large rams with strokes up to 160 in. and with dashpot cushions for either or both end heads. **—K–56**

Electrostatic Precipitators

A change in design to eliminate lubrication service on what is said to be one of the most vital components in electrostatic precipitators has been disclosed by Koppers Co.

According to the firm, the new design makes available in the pistons of precipitator rapping mechanisms operating advantages of industrial piston and sealing rings.

The new design provides the wearing surface of the rapping mechanism pistons with a layer of a special compound, identified as K-30, composed of Teflon and other wear-resistant materials. **—K–57**

BUSINESS NOTES

Agents Appointed

Golden-Anderson Valve Specialty Co. announces the appointment of Dorner Co. as its exclusive agent in the Milwaukee area and Gil Moore and Co. as its exclusive agent in the Boston area. The firm designs and manufactures valves for automation applications.

Plant Expansion Program

Completion of the company's two-year $600,000 plant expansion program was recently announced by Rust-Oleum Corp., Evanston, Ill. New additions include enlarged office space and a new company cafeteria in the administrative buildings. New production facilities in the manufacturing division include a three-story 12,000 sq ft warehousing unit, installation of new ball mill equipment, and a new automatic packaging system.

Expands Production Facilities

Roots-Connersville Blower Div., Dresser Industries, Inc., has completed a major expansion of its main plant.

The new integrated manufacturing department, occupying 40,000 sq ft, will be devoted to the production of rotary positive blowers, gas pumps and displacement gas meters, the firm reports.

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(Note: Students please write direct to manufacturer.)

When more than one advertisement appears on a page, the following code identifies the location of the ad on page: T-top, B-bottom, L-left, R-right, IFC-inside front cover, IBC-inside back cover, OBC-outside back cover.

Code number identifies location of item in Keep Informed Section—beginning page 161.

MECHANICAL ENGINEERING—MARCH 1958—Products Advertised

IFC	18,19	33-38	54	173	186R	197	213	229TL	244
1	20,21	39	155	174L	187	198-99	215	229TR	IBC
2	22	40	159	176T	188L	200	217	229B	OBC
4	23	41	160	176B	189R	201-02	219	230T	
6	24,25	42,43	162	177	190L	203	221	230BL	
7	26	44,45	163	178	191R	204	222	230BR	
8,9	27	46,47	164	179	193	205	223	231T	
10,11	28	48,49	165	180	194T	207	224	231BR	
12	29	50	167	181	194BL	208	225	232	
13	30	51	168	182	195	209	227R	239	
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MECHANICAL ENGINEERING—MARCH 1958—Keep Informed Section

K-1	K-12	K-23	K-34	K-45	K-56	K-67	K-78	K-89	K-100	K-111
K-2	K-13	K-24	K-35	K-46	K-57	K-68	K-79	K-90	K-101	K-112
K-3	K-14	K-25	K-36	K-47	K-58	K-69	K-80	K-91	K-102	K-113
K-4	K-15	K-26	K-37	K-48	K-59	K-70	K-81	K-92	K-103	K-114
K-5	K-16	K-27	K-38	K-49	K-60	K-71	K-82	K-93	K-104	K-115
K-6	K-17	K-28	K-39	K-50	K 61	K 72	K-83	K-94	K-105	K-116
K-7	K-18	K-29	K-40	K-51	K-62	K-73	K-84	K-95	K-106	
K-8	K-19	K-30	K-41	K-52	K-63	K-74	K-85	K-96	K-107	
K 9	K-20	K-31	K-42	K-53	K-64	K-75	K-86	K-97	K-108	
K-10	K-21	K-32	K-43	K-54	K-65	K-76	K-87	K-98	K-109	
K-11	K-22	K-33	K-44	K-55	K-66	K-77	K-88	K-99	K-110	

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KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Goes Into Production

Rockwell Mfg. Co. new 180,000-sq ft plant at Kearney, Neb., is now in limited production. Approximately 75 employees are at work in the new plant, which manufactures Rockwell-Nordstrom lubricated plug valves for the petroleum, natural gas, chemical, and other fluid-producing and fluid-using industries.

Improved Facilities

Superior Steel & Malleable Castings Co., Benton Harbor, Mich., announces the completion of a new addition to its plant with increased facilities for casting users.

The main office building of the foundry has been expanded to include modern drafting room and engineering department with adjoining stress laboratory, physical and chemical laboratories with additional facilities for gamma ray photography, and an enlarged and improved woodworking shop for pattern mounting, repair and alteration.

LATEST CATALOGS

Nuclear Engineering Services

A four-page illustrated folder describing the nuclear engineering services of Burns and Roe, Inc., is now available.

It describes the engineering and construction firm's work in nuclear power generation and reactor facilities, environmental testing, aviation test facilities, materials manufacturing, processing, and handling. —K–58

Furnace Deslaggers

Design points of furnace wall deslaggers are discussed in Bulletin 1034, published by Copes-Vulcan Div., Blaw-Knox Co.

Mechanical design of the units is illustrated by cross-sectional drawings, and schematic sketches show the major operational features of the swivel-tube rotation and retraction actions. —K–59

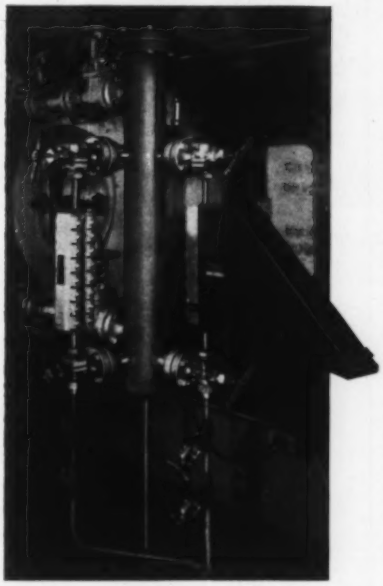
Electrochemical Products

A 16-page booklet describing physical properties of 23 products of the high temperature, electric furnace is announced by Norton Co.

Technical data is tabled and descriptions include present and possible future uses, availability of sizes and quantities and physical characteristics. Described are silicon carbide, zirconium oxide, zirconium carbide, calcium zirconate, boron carbide, boron nitride, boron, other borides, carbides and nitrides, and fused oxides. —K–60

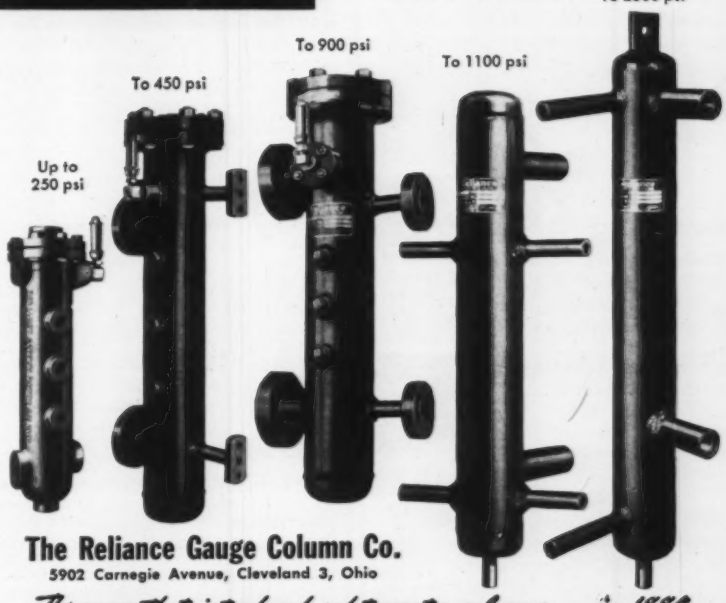
Insure safe, continuous boiler operation with

Reliance
Water Columns



Water columns have been around for a long time — ever since Reliance introduced the first one in 1884. Its chief reason for existence then was to carry the float-operated whistle alarm and mechanism, to warn operators of dangerously low water in the boiler. Since then, the water column has been developed in various styles and capacities to meet any power plant need. They are used on most boilers today as an accepted necessity, although many old time engineers — and thousands of young ones — can't explain their full usefulness. If you'd like to know "why a water column", write for free copy of our Liquid Level Letter No. 11.

Reliance makes Water Columns in seven pressure categories, five of which are represented below. And complete "trim" — gage cocks, gage valves, gage inserts, special gages and direct-to-drum assemblies. Write for information on equipment suited to your working pressure.



The Reliance Gauge Column Co.
5902 Carnegie Avenue, Cleveland 3, Ohio

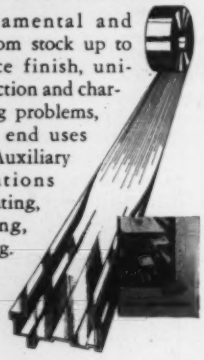
The name that introduced safety water columns....in 1884

Reliance®
BOILER SAFETY DEVICES

FREE YODER BOOKS OFFER "KNOW-HOW" on • ROLL FORMING • TUBE MAKING • SLITTING

COLD-ROLL FORMING

Structural, ornamental and tubular shapes from stock up to ½" thick. Surface finish, uniformity, stock selection and characteristics, plating problems, production costs, end uses and applications. Auxiliary automatic operations including perforating, notching, welding, coiling, embossing. 88 pages, fully charted and illustrated.



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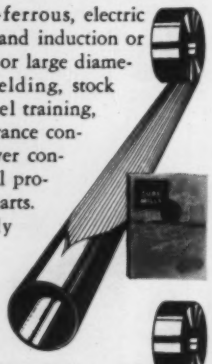

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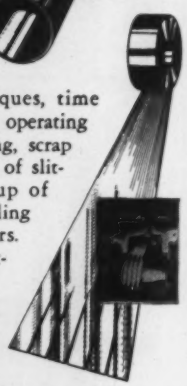

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Sealed Gear Pump

A new sealed gear pump for mounting on any machine which requires fluid circulation for lubrication or other purposes is pictured and described in a technical reference now offered by Bijur Lubricating Corp., Rochelle Park, N. J.

Two models are described: the Uni-directional, in which fluid flow reverses when shaft rotation reverses; and the reversible, in which fluid flow is always in the same direction regardless of shaft rotation. —K–61

Pneumatic Conveying Equipment

Fluor Products Co., announces a catalog illustrating a new line of bulk pneumatic conveying, ash handling, dust control, and air classifying equipment.

According to the firm, the new line is the result of a recent agreement with Maschinenfabrik Hartmann A.G., Offenbach, Germany. The German company has made available the design, manufacture, and sale of systems and equipment in North America. —K–62

Ni-Hard Castings

Nordberg Mfg. Co. has issued a 16-page bulletin describing its Ni-hard castings, made from nickel-chromium white cast iron which is claimed to have outstanding abrasion resistance.

Photos of the firm's facilities and finished castings, physical and chemical characteristics, and a conversion chart for comparison of the various recognized measurements of hardness are included. —K–63

Air Engineering

Niagara Blower Co. has published Bulletin 135 on air engineering for process industries.

Included is a collection of brief descriptions with some use and capacity information on apparatus manufactured by the company for use in chemical, food, metallurgical and plastics applications. Such functions as heat removal by the air method in process cooling, heat treating, vacuum distillation, refrigeration, air liquefaction are described. —K–64

Miniature Couplings

Non-Magnetic miniature couplings for use on servo-mechanisms, computers, missiles and other devices requiring small-size components for power transmission are described in Bulletin MC-100, announced by Thomas Flexible Coupling Co.

Except for stainless steel set-screws, the units are constructed of nonferrous materials such as anodized aluminum alloy, beryllium copper, and brass. —K–65

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BUSINESS NOTES
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Sliding Gate Control Valves

A six-page bulletin, J-180, describing sliding gate temperature control valves is available from Jordan Industrial Sales Div., OPW Corp.

Valve features and method of operation are described. The bulletin contains sizing charts, dimensional drawings, control ranges, material specifications and an accessory items list. **—K–66**

Automatic Boilers

A six-page bulletin describing operation of its Powermaster packaged automatic boiler is available from Orr & Sembower, Inc.

The boilers described are for both air atomizing and pressure atomizing for oil burning and also for gas. According to the company, the Powermaster is a completely self-contained, automatic unit. It is delivered factory pre-tested, completely assembled on its own steel base and ready to go into operation as soon as fuel, air and other lines are connected. **—K–67**

Mill Regulators

A six-page folder, Bulletin K-2503, describes a dual-circuit VSMR mill regulator, designed and built by Reliance Electric and Engineering Co.

The new fail-safe electronic regulator unit is designed to provide precise regulation of line speed, voltage, and tension for all continuous-process industries. Photos, drawings, and copy detail features and explain how, in the event of tube failure in one half of the panel, the other half instantly and automatically carries the entire load.**—K–68**

Solenoids, Switches

A four-page, two color bulletin, No. 1157LS, has been issued by G. H. Leland, Inc., to illustrate its line of Ledex rotary solenoids, selector switches, hermetically sealed selectors, and Syncramental stepping motors.

The bulletin contains a dimension and torque chart for all stock solenoid models, a cutaway drawing of the stepping motor, dimensional data on selector switches, a brief review of sealed selectors, and illustrations and descriptions of each product. **—K–69**

Vinyl Tubing

A new reinforced plastic PVC tubing that has been flexed to an angle of 90 deg over $1\frac{1}{2}$ million times without cracking or breaking and that will bend around a $\frac{5}{16}$-in. diameter spindle without its internal bore being reduced is illustrated and described in a two-color leaflet released by Newage Industries, Inc., 222 York St., Jenkintown, Pa.

A sample of Bardex is included with the leaflet that describes how the versatile tubing is weatherproof and resistant to gasoline, oils, high octane fuels and sea water. **—K–70**

Bubbles in boiling liquid were "frozen" with stop motion by photographer Bernard Hoffman.

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Blowers, Gas Pumps

Increased capacity ratings are given in a bulletin issued by Roots-Connersville Blower Div., Dresser Industries, Inc., on its line of Type AF rotary positive blowers and Type XA gas pumps.

The Blowers are manufactured in 18 sizes and capacities to 920 cfm for service from 1 to 10 lb pressure. The gas pumps are available in 18 sizes and capacities to 880 cfm for service from 1 to 7 lb pressure. The firm says both types of equipment are also well suited for vacuum service. —K-71

V-Belt Testing

A 16-page booklet, S-51107, covering the testing, inspection, and control of the quality of V-belts, has been issued by Goodyear Tire and Rubber Co.

The new booklet describes how raw materials and finished belts are tested and inspected. One section of the book explains quality control procedures, another is concerned with experimental production. —K-72

Packaged Speed Control Drives

Packaged drives for equipment requiring adjustable speed or speed synchronization are described in an eight-page bulletin available from Clark Controller Co.

Bulletin 20,000 describes the company's packaged speed control drives, which incorporate in one package the elements of adjustable-voltage d-c drives. The package includes a unit cabinet containing power conversion equipment and controls, one or more control stations, and drive motor or motors if desired. —K-73

Rotating Shaft Seals

A booklet describing the principle of retaining gases, oils, or other liquids under pressure has been published by the Rotary Seal Div., Muskegon Piston Ring Co.

Titled "Solving the Problem of Seals for Rotary Shafts," the booklet's 12-page text is supplemented by photographs and line drawing, including a cellophane overlay arrangement showing solutions to typical sealing problems encountered in machine design. —K-74

Properties of Steam at High Pressures

This is an interim steam table covering a range from 5500 to 10,000 psi and 32 to 1600 degrees F. It is published to provide a reasonable extrapolation of the current tables that will be useful in power systems calculations until an authoritative steam table has been published—five years hence.

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Double Pitch Roller Chains

Bulletin No. 507, including pricing and application information on standard attachments for standard and double pitch roller chains, is announced by Diamond Chain Co. —K–75

Silicone Products

Dow Corning Corp. announces its 1958 reference guide, describing more than 150 commercially available silicone products, including many introduced within the past year.

It contains detailed charts, tables, graphs, and data on properties and performance, along with illustrated examples. —K–76

Rotary Compressors

Rotary air compressors are described and illustrated in a brochure published by Kellogg Div., American Brake Shoe Co.

Said to be smaller and lighter than reciprocating compressors of equivalent output, the 1–2 hp pumps supply air in the 150–175 psi range. The eight-page, two-color folder explains principle of operation with cutaway diagrams, special features and details operating and mounting specifications. —K–77

Speed Reducers

Jones Machinery Div., Hewitt-Robins, Inc., Stamford, Conn., has issued a 40-page booklet on worm gear speed reducers.

It contains a description of various worm gear reducer designs with horsepower ranging from less than .1 to 121. Drawings and specification tables show designs and ratings for the many standard units available. —K–78

Diminutive Clutches, Brakes

Autotronics, Inc., has published a 28-page illustrated catalog covering its line of miniature and sub-miniature electro-magnetic clutches and brakes.

Included are cutaway drawings, engineering data, schematic diagrams, dimensional data, minimum performance curves, oscilloscope readings and other technical information. Photographs and copy describe the company's engineering, design and manufacturing facilities. —K–79

Commercial Fasteners

A 12-page catalog, Form 8-416, describing fasteners, blind rivets and driving tools for commercial and industrial application is announced by Huck Mfg. Co.

The catalog discusses features, specifications and uses of the firm's DR Daisy blind rivet, CL commercial Huckbolt fastener, OS oversize structural blind rivet, PT pull-thru blind rivet, and 9SP self-plugging blind rivet. The driving cycle for each fastener type is illustrated with a line drawing. —K–80

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Variable Speed Drives

Sterling Electric Motors, Inc., announces the publication of an eight-page colored brochure describing its line of variable speed drives.

The bulletin illustrates several Speed-Trol motor applications and contains selection information. Exclusive design advantages are described and illustrated. **—K–81**

Direct Reading Tank Gages

A two-page bulletin, F-40, describing direct reading tank gages for liquid storage tanks to 40 ft high, is announced by Jordan Industrial Sales Div., OPW Corp.

Features and material specifications are described and a photo shows a typical installation. Other tank fittings described include vents, emergency valves and drain valves. **—K–82**

Temperature Regulators

Spence Engineering Co., Inc. announces a six-page bulletin on two new series of steam regulating valves with pilots for fast and slow heat exchangers.

T134 or T124 pilots that handle heater pressures up to 50 psi are designed for instantaneous heaters, and the T14 pilot is designed for slow acting heaters to take full line pressures. A T14D pilot is designed for use when heater pressures must be limited. Selection tables and line drawings of applications are included in the bulletin. **—K–83**

Semi-Conductor Rectifiers

Allis-Chalmers line of semi-conductor rectifiers, germanium, silicon, and selenium, are described in a bulletin released by the company.

The bulletin, No. 12B8897, states the three types of semi-conductor rectifiers are applied for director currents and voltage ratings as indicated on a chart shown in the bulletin. Major advantage claimed for the semi-conductor rectifier is high conversion efficiency, up to 95 per cent when correctly applied. **—K–84**

Weather-Protected Motors

Features designed to contribute to outdoor dependability of its weather-protected Type FOD Motors built to NEMA and ASA standards in sizes NEMA frame 505 through 800 hp at 3600 rpm are described in a bulletin released by Allis-Chalmers Mfg. Co.

The bulletin, No. 51B8606B, describes the motors as featuring a sturdy steel frame, a removable prewound stator assembly, proved insulation, capsule-mounted split sleeve bearings, removable air ducts and protective screens. Standard Class A insulation is available at voltages to 4160 at a temperature rise of 50 C. **—K–85**

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BUSINESS NOTES
NEW EQUIPMENT
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Aircraft Fasteners

A 16-page illustrated catalog, Form 8-411, describing its line of AL aircraft fasteners and ALS aircraft stumps is now available from Huck Mfg. Co., 2480 Bellevue, Ave., Detroit 7.

The new catalog explains the nature of the two fastener types and describes their driving cycles. Included is such general technical information as material, heat treatment and finish specifications, strength properties, rate of installation and shop practice notes. Complete dimensional data are also provided. —K–86

Indexing Machine

Swanson-Erie Corp., 814 E. 8th St., Erie, Pa., announces a bulletin illustrating and describing its standard indexing machine chassis offered in 200 standard models for special purpose automatic machines.

Basic turret index models and the company's series L auto-tran straight-line indexing chassis are pictured. Data on the interchangeable features of the models. —K–87

Self-Aligning Couplings

Metal Products Div., Koppers Co., has announced the publication of a brochure on the use of Fast's Model B couplings. According to the company, this is the first low-priced, all-steel, gear-type, self-aligning coupling ever produced for shaft sizes up to $3^1/_8$ in.

The brochure outlines principle features of the line and points out that the double engagement design compensates for any type of misalignment of the shafts. Ratings and dimensions of the couplings are also included. —K–88

Sump, Process Pumps

Bulletin 726.2, describing its line of heavy duty vertical centrifugal sump and process pumps, has been issued by Goulds Pumps, Inc.

Single and duplex units and wet and dry pit types are covered. The units are available for pit depths up to 20 ft with capacities to 1080 gpm and heads to 290 ft. The bulletin includes specifications, sectional views, performance ratings, and a chart of materials of construction for interchangeability. —K–89

Industrial Electric Heating

A booklet on industrial electric heating units and devices is available from Westinghouse Electric Corp. The 24-page booklet describes such units as strip heaters, oven heaters, immersion heaters, bolt heaters and industrial hot plates.

Heating problems and their solutions are discussed with the aid of graphs and charts in the booklet's heater selection guide. Compatible heater control equipment is also featured. —K–90

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

High Altitude Data

A wallet size card showing environmental data at altitudes from 0 to 1,800,000 ft is offered by Kinney Mfg. Div., New York Air Brake Co.

The tables given include temperatures at all elevations, as well as pressures in mm Hg, in. Hg, and psi. **—K-91**

Industrial Hose

A 32-page catalog of industrial hose couplings, stems, swivels, and accessories has been released by J. N. Fauver Co.

Sections of the catalog include application, selection, and mounting of hose; hose types; reusable type couplings; adaptors for swivel reusable couplings; straight and angle swivels; hose couplings; how to apply hose clamps; how to remove and install circle clamps; hose stems; hose assemblies. **—K-92**

Air Handling Units

Engineering information on recently announced low pressure sprayed coil and high pressure dry and sprayed coil air handling units is incorporated in a revised catalog announced by Trane Co.

The 56-page catalog provides descriptions and illustrations on all-purpose air conditioners for commercial, institutional and industrial comfort and process applications. According to the firm, its Climate Changer units can be used for one or all phases of air conditioning. Sixty-five combinations are available. **—K-93**

Machinery Mountings

A catalog giving data on stopping vibration, shock, and noise transmission by using steel spring machinery mountings has been published by Korfund Co.

Bulletin K3B explains reasons for using springs in controlling vibration, and describes the firm's Series L vibro-isolators. A series of eight case histories, with actual installation photos, describe how the machinery mountings solved a representative range of vibration and shock problems. **—K-94**

Dust Collector Valves

Two bulletins, describing free-discharge valves for dry dust collectors, are available from the Ducon Co.

Bulletin V-957 gives application information, engineering, and dimensional data on the Type C two-door discharge gate, applicable for dry flowable materials, particularly those of an abrasive nature, or for products where minimum breakage to individual particles is required. Bulletin V-6157 describes Type FA trickle valve, which uses gravity for automatic operation, with no auxiliary power required. **—K-95**

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BUSINESS NOTES
NEW EQUIPMENT
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Vibratory Equipment

Syntron Co., announces publication of a 60-page condensed catalog of its vibratory bulk materials handling equipment and other products.

Products listed include vibrators, packers and jolters, car rappers, hopper level switches, flow control valves, feeders, screens, parts feeders, lapping and polishing machines, shaft seals, paper joggers, selenium rectifiers and rectifier units, infra-red heating elements and panels, power tools and concrete finishing equipment. —K–96

Hydraulic Tables Data

A bulletin containing hydraulic tables and other engineering data has been published by Hamilton Div., Baldwin-Lima-Hamilton Corp.

The 40-page bulletin, No. 3300, describes and illustrates the firm's presses for such applications as producing laminated plastics, pressing dry ice, die hobbing, preforming and plastics and metal-powder compacting. The bulletin furnishes conversion tables, decimal equivalents, hydraulic ram capacities, wire and sheet metal gages, steel pipe tables, bolt tables, specific gravities, and strengths of materials. —K–97

Synchronous Motor

Bulletin PB-117, giving technical, operational and design data on its new permanent magnet synchronous motor, is announced by Cramer Controls Corp.

Specifications on five versions of the Type 117 motor series, including torque ratings to 60 in.-oz, speeds, shaft dimensions, materials and construction, are included. —K–98

Seamless Mechanical Tubing

A technical data card available from the Tubular Products Div., Babcock & Wilcox Co., supplies data taken from the new edition of the steel tubular products section of the AISI Steel Products Manual.

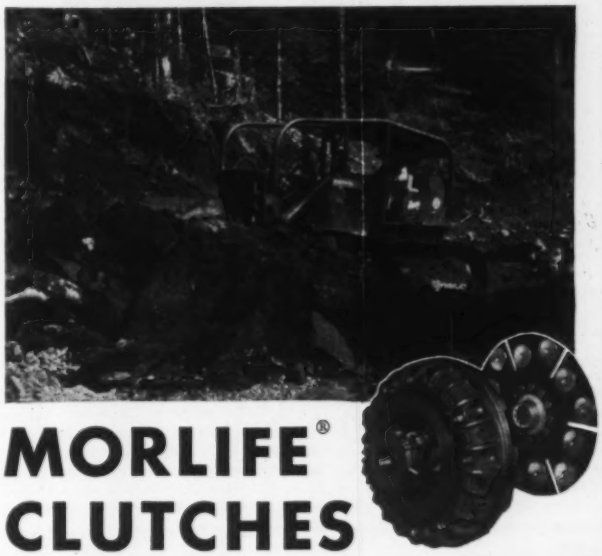
The data card No. TDC-1150, covers important dimensional tolerances, both cold-drawn and hot-finished, of round, seamless carbon, and alloy steel mechanical tubing in various conditions of heat treatment. —K–99

Self-Locking Socket Screws

Microsize socket head cap and set screws with a self-locking feature are the subject of a bulletin offered by Standard Pressed Steel Co.

The four-page booklet shows in text and drawings the firm's Nylok insert, a resilient nylon pellet seated into the threaded portion of the fasteners. This insert presses against the mating thread of a tapped hole or nut to prevent the loosening caused by shock and vibration, the company states. —K–100

ROCKFORD



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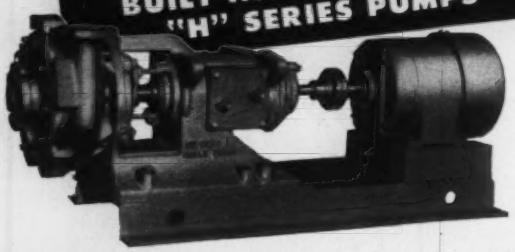
Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

ROCKFORD B-W BORG-WARNER

CLUTCHES

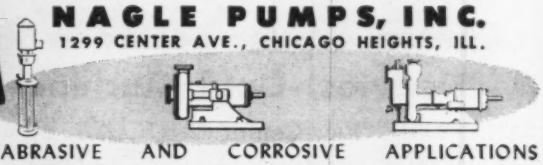
"INTESTINAL FORTITUDE" BUILT INTO NEW NAGLE "H" SERIES PUMPS



The new "H" Series of Nagle Pumps, designed exclusively for the abusive pumping jobs of industry, is simplicity itself. Three types of water ends available to meet specific conditions, type "HF", "HC" and "HR" (shown). Various alloys used for water-end members depending upon corrosive, abrasive or high temperature conditions involved. Water-end can be rotated to any one of four discharge positions. Slippage seal adjustment takes only moments using a common wrench. Packing gland is readily accessible. Radial adjustment of shaft to insure concentricity through stuffing box is a matter of seconds. Various types of impellers available. Impellers readily accessible. Oil or grease lubrication is optional. Sizes from 1" to 10". Heads up to 250' or more. Capacities to 4,000 G.P.M. A "must" for those tough applications where ordinary pumps fail. Send for Bulletin "H"

NAGLE PUMPS

NAGLE PUMPS, INC.
1299 CENTER AVE., CHICAGO HEIGHTS, ILL.



PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

Over 85% of the torque wrenches used in industry are

STURTEVANT TORQUE WRENCHES

Read by Sight, Sound or Feel.

- Permanently Accurate
- Practically Indestructible
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- Automatic Release
- All Capacities

in inch grams...inch ounces...inch pounds ...foot pounds (All sizes from 0-6000 ft. lbs.)

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VISCOSITY OF LUBRICANTS UNDER PRESSURE

This Report reviews twelve experimental investigations made in England, Germany, Japan, Russia, and the United States on 148 lubricants comprising 25 fatty oils, 94 petroleum oils, 17 compounded oils, and 12 other lubricants. Data collected are co-ordinated by means of sixty tables in which the results originally appearing in diversified units are compared. The methods proposed for correlating viscosity-pressure characteristics of oils with properties determined at atmospheric pressures are reviewed and illustrated. Pertinent topics such as experimental work on heavily loaded bearings, lubrication calculations, and additional techniques for viscosity are covered. Conclusions and recommendations are presented. Other sections give the required computation of temperature and pressure coefficients, a bibliography of 189 items, and symbols.

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KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Adjustable Speed Drive

Louis Allis Co. has published a 12-page bulletin, No. 2000, on its Select-A-Spede adjustable speed drive.

The unit, available from 5 to 200 hp, is described as a variable-voltage d-c drive that uses a-c as its power source. Applications in machine tools, metal processing, textile, paper making, test stands and conveyors are discussed and illustrated. —K-101

Hydraulic Presses

Bulletin 157, 16 pages, published by Lake Erie Machinery Corp., 1001 Woodward Ave., Buffalo 17, N. Y., covers the firm's line of hydraulic presses.

The bulletin describes facilities, engineering and production in detail and lists the equipment available for the manufacture of developed designs or the design, machining, assembly, and testing of completely new industrial machinery. —K-102

Diminutive Clutches and Brakes

Autotronics, Inc., has published a 28-page illustrated catalog covering its line of miniature and sub-miniature electro-magnetic clutches and brakes.

Included is information on each type of clutch and brake produced, including cutaway drawings, engineering data, schematic diagrams, dimensional data, minimum performance curves, oscilloscope readings, and other technical information. Also included are photographs and description of the company's engineering, design, and manufacturing facilities. —K-103

Multi-Jet Condensers

Bulletin 5AB published by Schutte and Koerting Co., describes the company's line of low-level condensers for condensing steam, under vacuum, at ground level.

The units reported to be used in industrial processes and in connection with steam engines and turbines. According to the firm, the range of capacities offered by the units, and the fact that they discharge directly into a hotwell make them ideal for the average steam unit or industrial installation designed to operate under vacuum. —K-104

Precision Ball Bearings

A 12-page booklet on ball bearing yield and system isoelasticity has been prepared by Barden Corp.

The booklet is designed to assist in the application of precision instrument bearings. It offers background data on radial and axial play, axial take-up and preloading, isoelastic bearings and achievement of system isoelasticity. A section on requirements for spin axis bearings subjected to transient or vibratory forces is included. —K-105

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Vacuum Melting Furnace

The firm's Model 436 induction heated vacuum melting furnace with a melt capacity of 50 lb is described in a data sheet, No. 660, published by Vacuum Equipment Div., F. J. Stokes Corp.

Among the features cited are: 50 cu ft water-jacketed split chamber with full-opening dolly-mounted door; provisisons for pouring multiple molds, introducing power or water into the chamber for pre-heating or cooling the molds, taking melt samples, and making corrective additions. —K–106

50-Ton Compacting Press

Features and performance of its new 50-ton compacting press for powdered metals, plastics, ceramics, carbides, cermets, and ferrites are described in a bulletin published by Hamilton Div., Baldwin-Lima-Hamilton Corp.

The two-color, four-page bulletin, No. 3107, provides general information, specifications, illustrations, and data. Designated Model 50W, the press has a welded frame and is a mechanical, eccentric type with flywheel, pneumatic clutch, and spring brake. It is powered by a variable-speed drive unit which incorporates a 7½ hp totally enclosed fan-cooled motor. —K–107

Hot-Melt Adhesive

An adhesive said to be particularly suitable for holding parts together during assembly has been developed by Adhesives Dept., of Raybestos-Manhattan, Inc., Bridgeport 2, Conn.

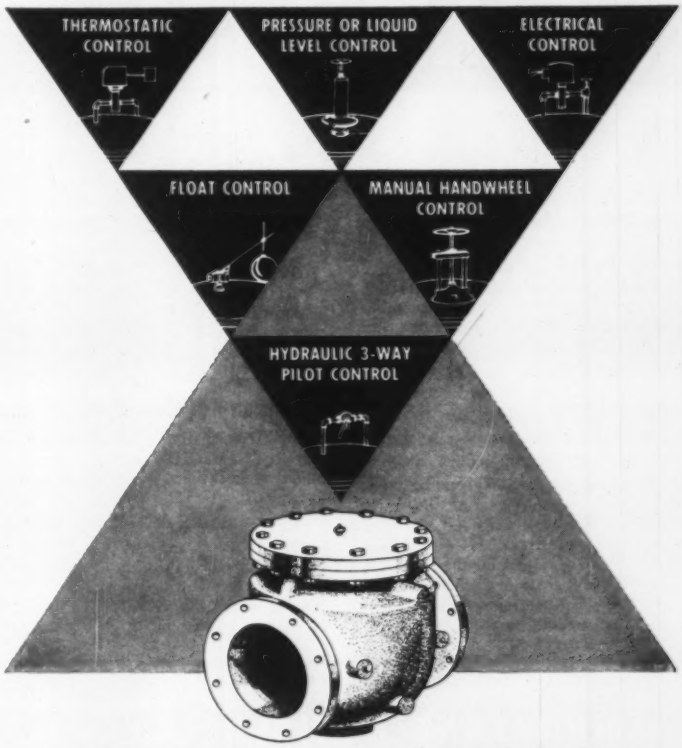
It is designated as Ray-BOND R-84001, and is described as a hot-melt adhesive which provides instant grab when applied to glass, etched Teflon, Mylar, polystyrene, polyethylene, and almost any other material.

The material may also be used as a permanent binder provided temperatures do not exceed 150 F, the company reports. A 1-sq in. lap joint made from strips of Mylar will hold a dead load of 50 lb at 73 F and a load of 6 lb at 150 F, the firm states.

It is composed entirely of solids, and is supplied in a semi-brittle state. It is liquified by heating to 250 F and applied in the fluid state to one of the parts to be assembled. The other part is immediately pressed into contact and the two held together until the adhesive cools. The strength of the bond increases as the adhesive cools to room temperature.

The company points out that an alternative bonding method is to apply the melted adhesive to one of the parts, allow it to solidify, place it against the mating member when ready to assemble and hold a hot iron on the assembly until the adhesive has melted. This method is especially recommended for bonding Mylar. —K–108

Select the CONTROL you want for Automatic Valve Operation . . .



with the G-A Cushioned FLOWTROL VALVE

• Operates automatically with any fluid, any control • Angle or globe body, bronze or non-corrosive liner • Air and fluid cushioning prevent hammer in closing • Available sizes 2" to 36" for pressures to 250 psi

GOLDEN ANDERSON Valve Specialty Company
1223 RIDGE AVENUE, PITTSBURGH 33, PA.

Write for Bulletin W-8A

Designers and Manufacturers of VALVES FOR AUTOMATION

Weather-Protected Motors

Weather-protected motors with enclosures built to NEMA Type II standards to meet requirements of outdoor service are described in a bulletin released by Allis-Chalmers Mfg. Co.

The bulletin, No. 05B7874C, gives construction and mechanical features of the motors which are available in all commonly used ratings, both horizontal and vertical, 250 hp and above. According to the company, the motors can be obtained with all-silicone-rubber insulating system which produces stator coils that are impervious to moisture and other air-borne contaminants, highly resistant to abrasives, and thermally stable at extreme operating temperatures. —K–109

Induction Heater

Construction and design features of Allis-Chalmers high-frequency induction heaters and induction melting furnaces are described in Bulletin, 12B6430B, released by the company.

The units are available in output ratings from 10 to 100 kw. According to the company, the completely self-contained induction heater is being used for rapid soldering, annealing, melting, brazing, hardening, and forging operations. For applications beyond the range of vacuum tube induction heaters, the firm produces motor-generator induction heaters in output ratings from 15 to 1250 kw at frequency ratings of 960, 3000, and 9600 cycles. —K–110

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Shaft Mounted Drives

A 32-page illustrated bulletin, No. 7100, describing the firm's line of all-steel, helical gear, shaft mounted drives for applications from $^1/_2$ to 50 hp and from 420 to 5 rpm output speed, is announced by Falk Corp.

The new bulletin includes description of unit design and construction and suggestions on the application of the drives. Installation photos and selection of proper size and ratio of unit, including new high-ratio units and new size, are covered. **—K-111**

Industrial Filters

Sparkler Mfg. Co. has issued a revised bulletin, No. 2202, covering its line of filters.

Included are condensed engineering data, capacity tables, and specifications on water filters with capacities to 5,000,000 gpd, heavy duty filters for products with a high percentage of solids, filters for fine filtration and polishing, and specialized filters for hydraulic oil, plating solutions, varnish, lacquers, and sugar refining. **—K-112**

High Pressure Pumps

A 12-page illustrated bulletin on Triplex pumps has been issued by Kobe, Inc.

The pumps are described as being in use in many industrial plants where pressure up to 20,000 psi and temperatures in excess of 500 F are required. Applications include operation of hydraulic test equipment, molding pressures, lubricating systems, and oilwell pumping. **—K-113**

Corrosion Resistant Fastenings

H. M. Harper Co. has issued a net price catalog covering its line of nonferrous and stainless steel bolts, nuts, screws, rivets, and washers.

Each type of fastener is illustrated and its sizes and prices are shown in tabular form. Included in the 84-page catalog are corrosion resistant fastenings of brass, Navy bronze, silicon bronze, copper, nickel, monel, stainless steel, and aluminum. **—K-114**

Flexible Connectors

Cobra Metal Hose has issued Forms 1K-1 and 1K-3 giving data and prices on bronze heavy duty flexible connectors for conveying gases, liquids, and semi-solids and its line of flexible pump connectors, nipples, and noise absorbers.

Size, working pressure, price, and shipping weight of the various units are outlined in table form. **—K-115**

Stock Gears, Speed Reducers

Charles Bond Co., announces Catalog 100, covering stock gears, speed reducers, sprockets and chains, flexible couplings, universal joints, collars and pillow blocks.

The catalog contains charts for selection of speed reducers and stock gears. A feature of the 80-page catalog is color coding in which sections are assigned distinctive colors and a color-key appears on the front cover for quick location of material. **—K-116**

IMPORTANT NOTICE!

NICE ANNOUNCES ITS APPOINTMENT AS THE SOLE LICENSEE IN THE UNITED STATES FOR THE MANUFACTURE AND SALE OF THE MOST AMAZING BEARING IT HAS EVER WITNESSED. IT FEATURES A SOLID INNER AND SOLID OUTER RACEWAY, WITH DEEP, UNBROKEN BALL GROOVES *AND A FULL COMPLEMENT* OF BALLS. A BALL SEPARATOR MAY BE INCORPORATED, BUT IN EITHER CASE, THERE IS NO LOADING SLOT OR SPLIT RACE TO ADMIT THE BALLS TO THE BEARING. IT WILL BE SOLD AT VERY ATTRACTIVE PRICES, USUALLY WITHOUT COST PENALTY AS COMPARED WITH COMPETITIVE BEARINGS OF COMMERCIAL QUALITY, YET IT WILL BE A SUPERIOR BEARING. PATENTS THROUGHOUT THE WORLD ARE COVERED BY HEIM - *Unibal*®.
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DIVISION OF CHANNING CORPORATION

The ADDED Ingredient...
KNOW-How—
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In Industry, in homes, farms and shops, you'll find daily, living proof that D-&-B's KNOW-HOW pays out in EXTRA performance. Rely on expert engineers for parts that meet your exact needs and save you MONEY! Get Wire Forms, Springs and Stampings that are easily assembled . . . that withstand stress . . . and perform under the most trying conditions!
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Get positive piping protection with

ZALLEA NON-EQUALIZING EXPANSION JOINTS . . .

Zallea Non-Equalizing Corrugated Expansion Joints offer a degree of protection that can't be equalled for absorbing movement of piping due to temperature changes. They protect interconnected equipment by absorbing movements in otherwise rigid piping systems. They are used in low pressure and vacuum lines . . . between stills, tanks, columns, condensers, pumps and similar equipment.

Standard Sizes: 3″ to 72″ dia.; Special sizes to 50 ft. dia. Pressures: Vacuum to 50 psig. Temperatures: to 1600°F.

Special Applications. With the addition of proper components, Zallea Non-Equalizing Expansion Joints can be used as:

Universal Expansion Joints to absorb movement in any direction . . . axially, laterally, angularly, or any combination of these.

Pressure Balanced Expansion Joints to absorb axial movement outside the unit and still carry pressure thrust.

Hinged and Gimbal Expansion Joints for piping systems that cannot be anchored in the conventional manner.

Get the complete story of Zallea Expansion Joints in our new 72-page manual. They are available for any pressure condition to 3600 psig. Write, on your company letterhead, for your copy of Catalog 56.

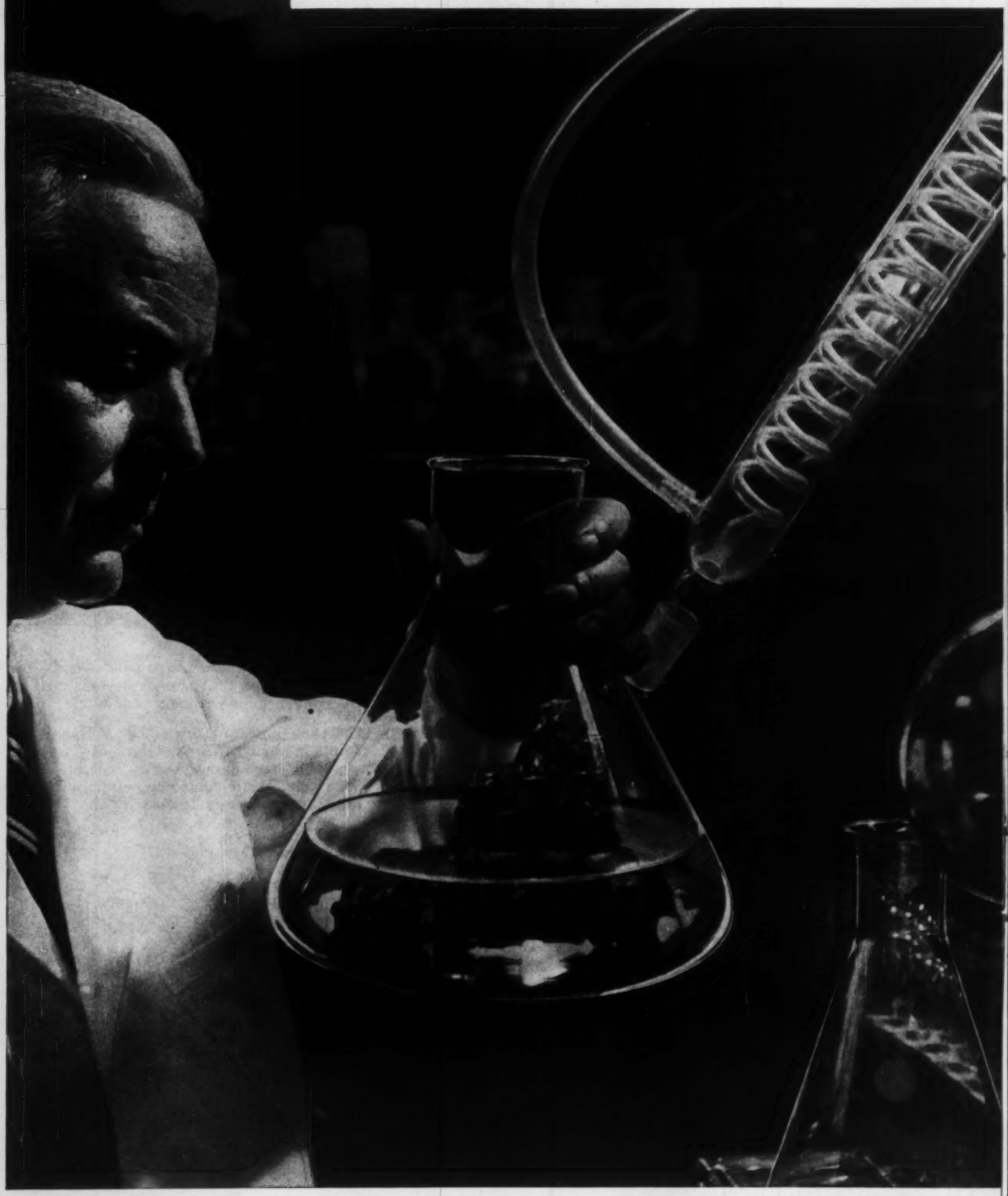
Zallea
expansion joints

Zallea Brothers • Wilmington 99, Delaware

World's largest manufacturers of expansion joints

Large Zallea Non-Equalizing Expansion Joint installed on deaerating heater of Ford Motor Company's River Rouge plant.

Textile processor finds



fuel cost solution in coal

Kerr Bleaching & Finishing Works' modern equipment cuts steam costs 33%, manpower 67%.

A reliable source of steam is a necessity in bleaching and finishing textile products. So when production demands at Kerr Bleaching & Finishing Works, Concord, N. C., called for additional steam capacity, the firm decided to build a new power plant. Coal was chosen as the fuel on the basis of cost studies.

A new boiler and modern coal handling system were installed. Automatic controls regulate the operation. The results were a 50% increase in steam capacity and a 67% reduction in manpower . . . with overall fuel and operating costs cut over 33%!

This modern unit was so successful—providing trouble-free operation and low-maintenance cost—that when even greater capacity was needed, an identical new unit was added. And, of course, no increase in operating crew was necessary!

Facts you should know about coal

Not only is bituminous coal the lowest-cost fuel in most industrial areas, but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment pares labor costs and eliminates smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

To help you with industrial fuel problems the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send for our case histories, complete with data sheets. You'll find them informative.

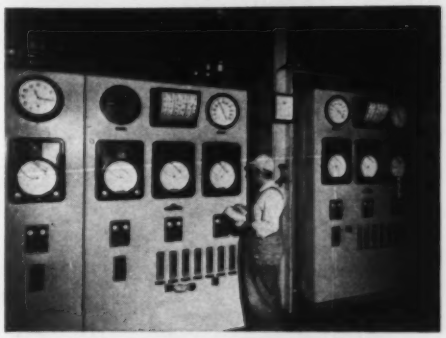
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

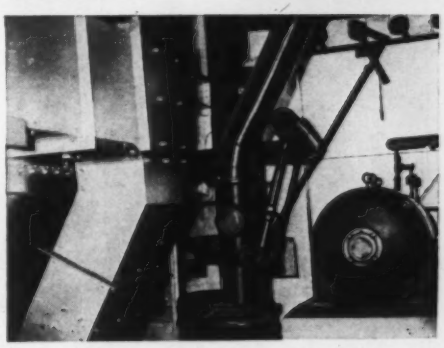
BITUMINOUS COAL INSTITUTE

Southern Building • Washington 5, D. C.

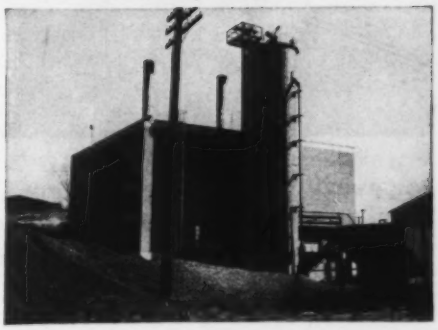
Firing aisle at the power plant of Kerr Bleaching & Finishing Works, showing two Babcock & Wilcox 60,000 lb/hr boilers—the more recent on the right. Fired by Detroit spreader-type Rotostoker, with steam-powered dump grates.



Control panels of Bailey Pneumatic Control System. Fuel feed, draft dampers, feedwater control—entire combustion operation is automatically regulated by this system.



View in rear of Boiler No. 2. Pipe in center of photograph returns fly ash from collector to furnace to be burned again. Motor on the righ: drives induced draft fan.



Rear of Kerr's power plant showing the 250-ton coal storage silo. Coal is dumped into hopper by railroad car and carried by horizontal conveyor to bucket elevator at silo. Reserve coal pile is shown at left.

POWELL

world's largest family of valves

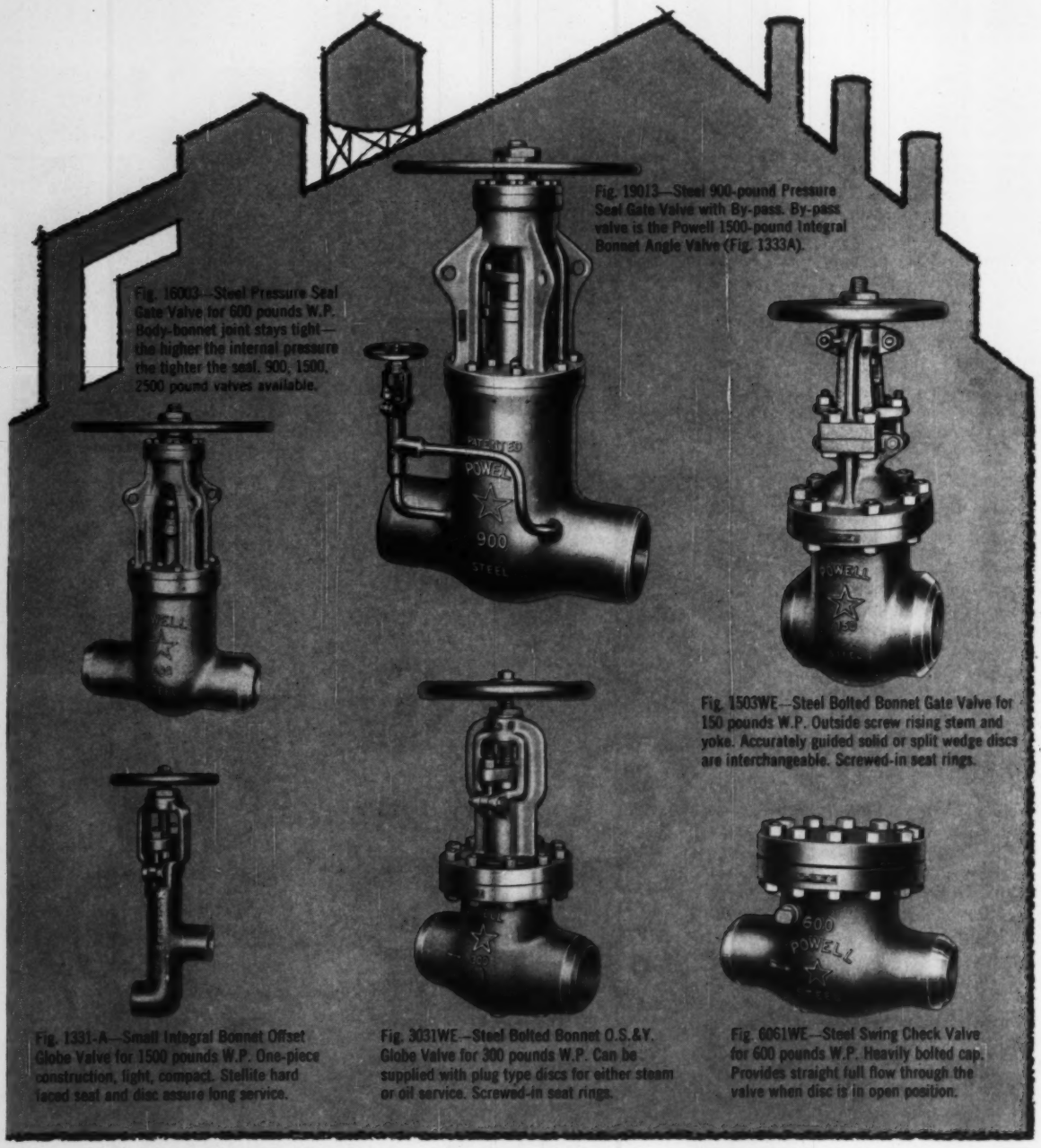
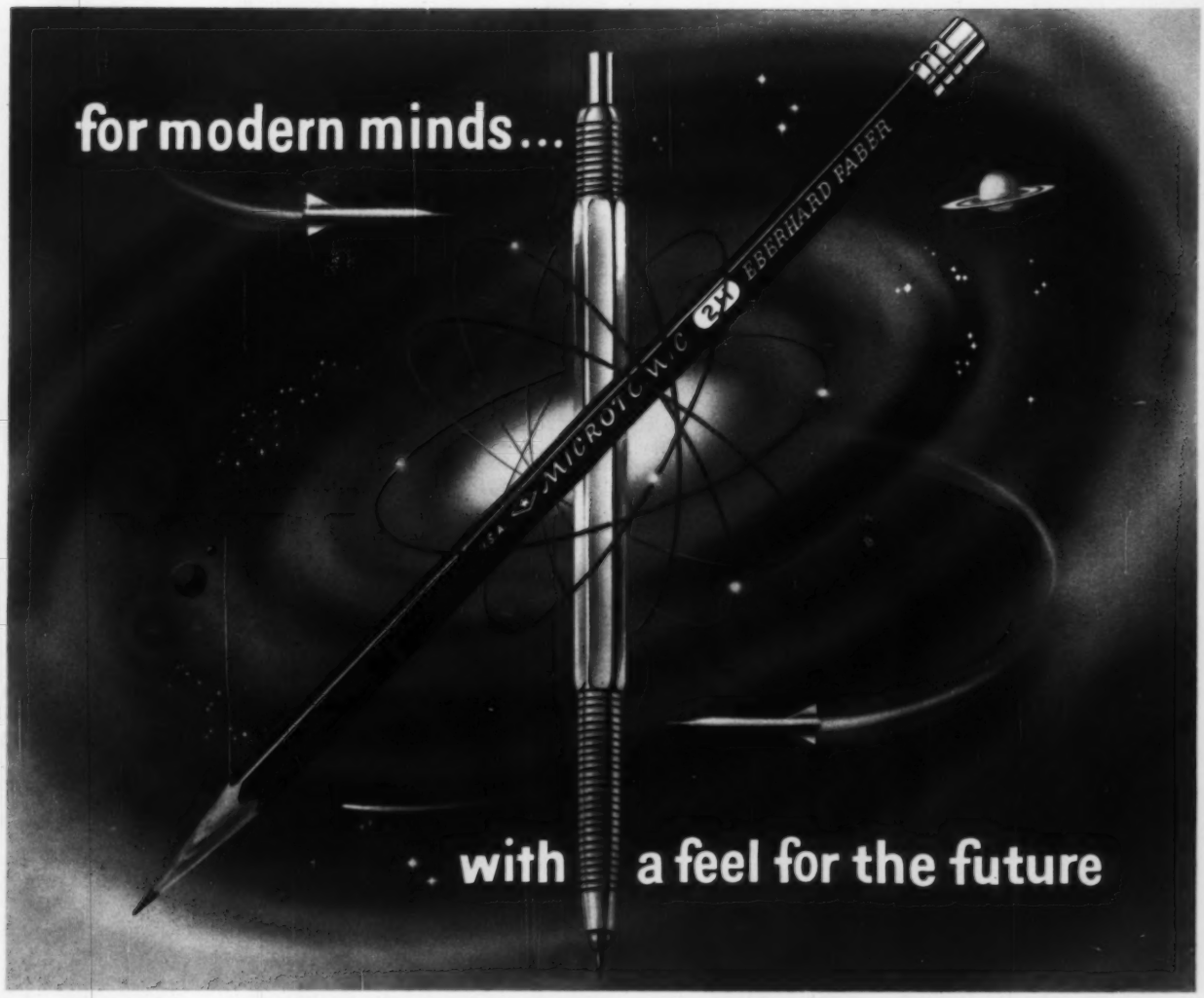


Fig. 19013—Steel 900-pound Pressure Seal Gate Valve with By-pass. By-pass valve is the Powell 1500-pound Integral Bonnet Angle Valve (Fig. 1333A).
Fig. 16003—Steel Pressure Seal Gate Valve for 600 pounds W.P. Body-bonnet joint stays tight—the higher the internal pressure the tighter the seal. 900, 1500, 2500 pound valves available.
Fig. 1503WE—Steel Bolted Bonnet Gate Valve for 150 pounds W.P. Outside screw rising stem and yoke. Accurately guided solid or split wedge discs are interchangeable. Screwed-in seat rings.
Fig. 1331-A—Small Integral Bonnet Offset Globe Valve for 1500 pounds W.P. One-piece construction, light, compact. Stellite hard faced seat and disc assure long service.
Fig. 3031WE—Steel Bolted Bonnet O.S.&Y. Globe Valve for 300 pounds W.P. Can be supplied with plug type discs for either steam or oil service. Screwed-in seat rings.
Fig. 6061WE—Steel Swing Check Valve for 600 pounds W.P. Heavily bolted cap. Provides straight full flow through the valve when disc is in open position.

For every flow control problem Powell offers more kinds or types, available in the largest variety of metals and alloys to handle every flow control requirement. Powell distributors are located in all principal cities and maintain inventories to fill almost any need. For special engineering problems, write direct to:

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**



NEW IMPROVED MICROTOMIC DRAWING PENCIL—No. 600—the choice of professionals in modern streamline dress. Identified by new chrome top cap. 18 uniform degrees. Bull's eye marking to identify degree.

NEW MICROTOMIC HOLDER—No. 607—Lightweight scientifically balanced aluminum barrel with knurled finger grip. Improved positive-grip clutch with quick push button release. Colored tips identify lead degree.

THE NEW IMPROVED

MICROTOMICS

NEW ONE HAND FLIP-TOP MICROTOMIC LEAD INSERTOR —No. 6100—plastic box. Attractive vest pocket size. Holds 1 dozen drawing leads, .079" dia. x 5" long, all pointed. 17 degrees. Just flip the top and, without touching the lead, insert lead quickly into holder.

Get the feel of the future at your drawing board. Share the thrill of scientific achievement—drawing and drafting in the Microtomic Age! Sweeping style changes make Microtomics as exciting as projects you are working on. Microtomic leads take strong, keen point... reproduce clean, sharp lines, rich and black.

Since 1849 **EBERHARD FABER** puts its quality in writing

WILKES-BARRE, PA. • TORONTO, CANADA

Write on Company letterhead for further information about new improved Microtomic Pencils.

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E. M. Fuhrer Litho Co., N. Y.

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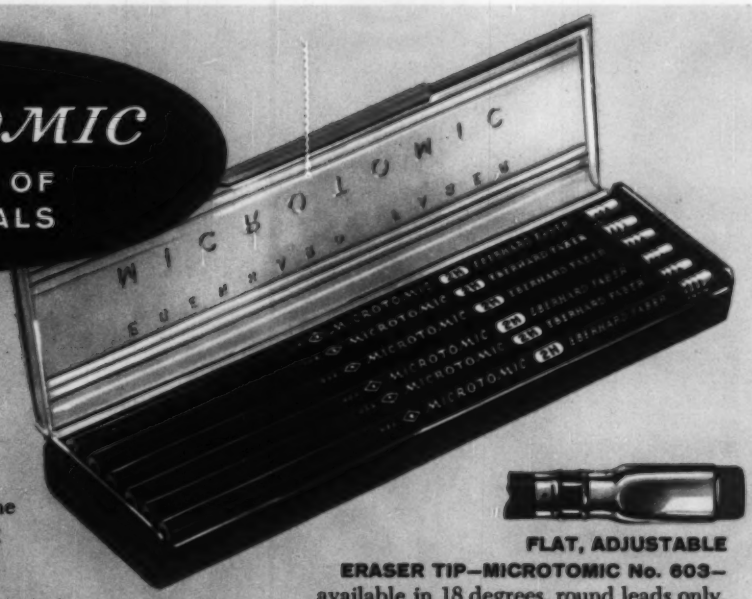
MICROTOMIC

THE CHOICE OF PROFESSIONALS



NEW MICROTOMIC PLASTIC BOX—No. 600
—handsome. Reusable. Holds one dozen MICROTOMIC drawing pencils. 18 accurate degrees.

FLAT, ADJUSTABLE ERASER TIP—MICROTOMIC No. 603— available in 18 degrees, round leads only.

MICROTOMIC CHISEL POINT—No. 600 DRAWING PENCILS—AVAILABLE IN 6 DEGREES

Erase without a trace with EBERHARD FABER Paper Mated Erasers

RACE KLEEN PLASTIC ERASER —No. 521—superior on special drafting and tracing papers...vellums and plastic coated stocks. Soft, gentle, extremely pliable. Contains no abrasives. Double beveled.

PINK PEARL—No. 101—favorite of artists, draftsmen and architects. Soft and pliable—won't mar paper surface. Beveled shape. Smaller size —No. 100. Convenient paper wrapped pencil shape—No. 400.

RUBKLEEN—No. 6002—the perfect all-purpose cleaner. Soft and gentle yet long-wearing. Very little crumbling. No greasy film. Extra large size—No. 6004. Paper wrapped pencil—No. 6001.

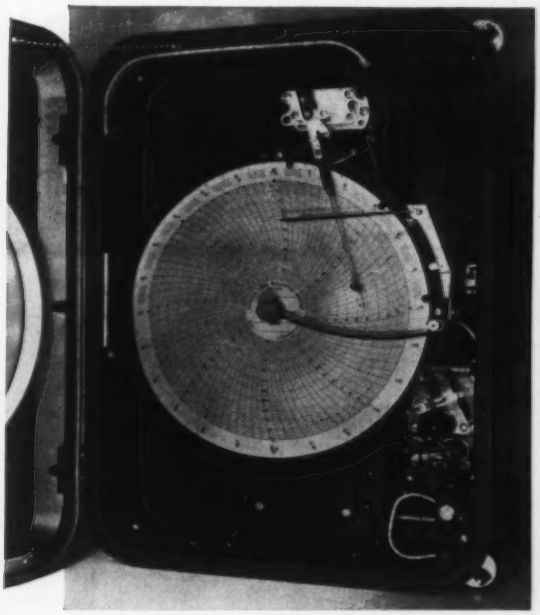
EBERHARD FABER • WILKES-BARRE, PA. • TORONTO, CANADA

RING BALANCE FEATURES No. 4

ELECTRIC TRANSMISSION

with the versatile new PowrLog

ELECTRONIC RECEIVER



Complete assembly with amplifier in place. Flow integrator may be added for complete records.

The Hagan PowrLog Electronic Receiver brings a new standard of accuracy and dependability to the remote transmission of all standard variables. In applications where the transmitter is a Ring Balance meter equipped with slide wire, the PowrLog receiver can record, integrate and indicate fluid flow with or without compensation for pressure and temperature, fluid density, liquid level in open or closed vessels, boiler drum water level. Used with suitable amplifiers, the field of application widens to include temperature, heat exchange and other variables.

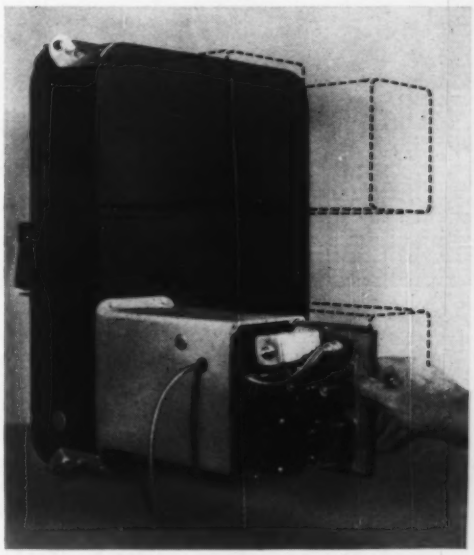
Interchangeable, plug-in, input boxes quickly adapt the PowrLog to operation with AC or DC inputs. Up to four records can be made simultaneously or control can be accomplished through coupling to the Ring Balance pneumatic transmitter-controller.

Unaffected by mechanical friction or power supply fluctuations, the PowrLog offers these operating characteristics:

Resolution	0.15% of full scale
Repeatability	0.25% full scale
Over-all Accuracy	0.5% full scale
Pen Travel Time	2 seconds full scale (0.5 sec./inch)

Input Ranges:

AC Bridge	1000 ohm transmission potentiometer
DC Potentiometer	0-0.1 v. to 0-1.3 v.
DC Voltmeter	500 volts maximum



Printed circuit amplifier chassis slides readily into housing. Note that as many as four units may be used in a single instrument case.

Remember, the Hagan Ring Balance meter offers you all these features, too:

1. Ease of calibration under operating static pressures with factory calibrated check weights matched to each meter. No more four-story water columns and telephones!
2. Safe operation with rings rated at 2,500, 6,000, 15,000 psig. No gaskets, no stuffing boxes.
3. Sealing fluid density and level not critical. No eyedroppers required to maintain calibration.
4. Interchangeable ring assemblies for full scale ranges from 0.5" w.c. to 560" w.c. Adjustment on any one ring over a 7:1 differential range easily and quickly accomplished.
5. Wide range computation and/or compensation by means of built-in, easily checked mechanisms available on most models.
6. Any Ring Balance meter can be equipped with slide wire for operation with data-logging devices and for transmission to the PowrLog.

For full details on the Hagan PowrLog, write for Bulletin MSP 149.

HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
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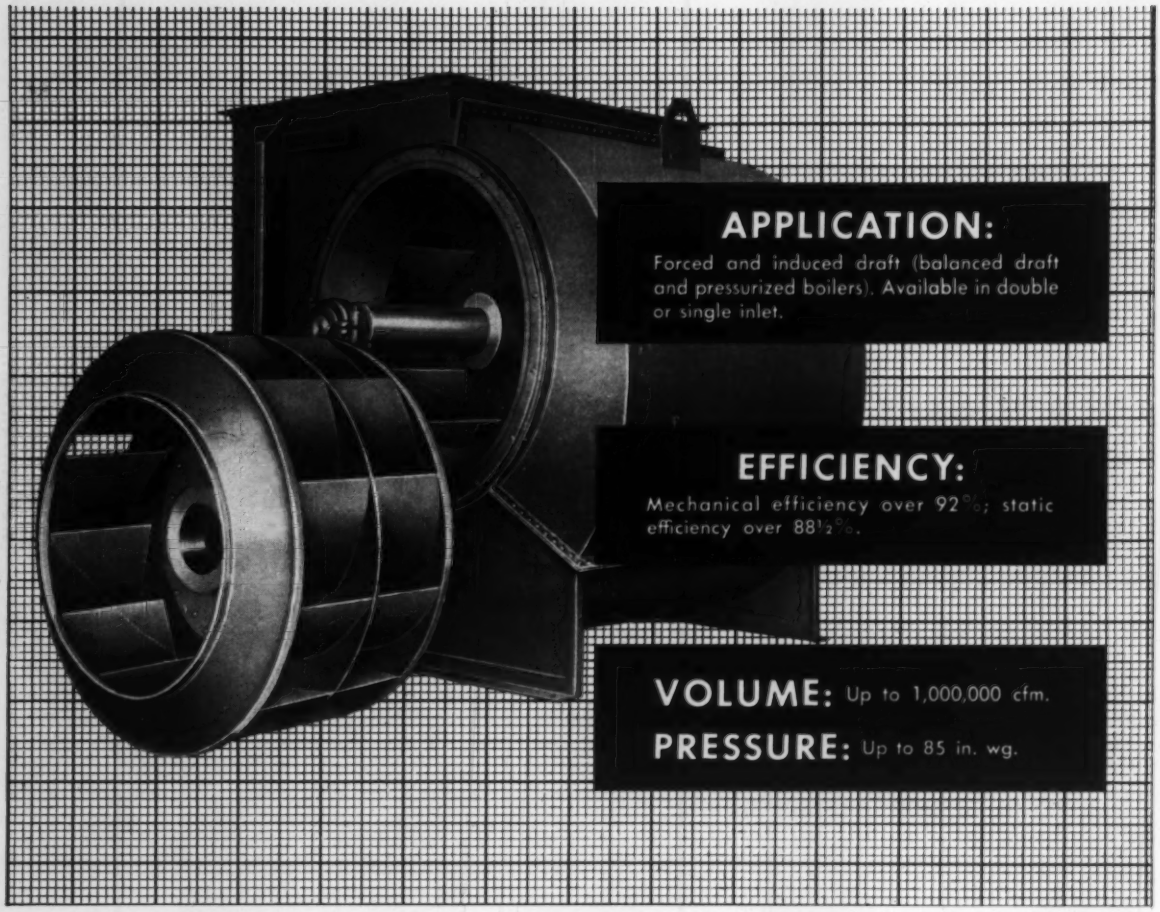
AMERICAN BLOWER AIRFOIL FANS


APPLICATION:
Forced and induced draft (balanced draft and pressurized boilers). Available in double or single inlet.
EFFICIENCY:
Mechanical efficiency over 92%; static efficiency over 88½%.
VOLUME: Up to 1,000,000 cfm.
PRESSURE: Up to 85 in. wg.

If you're thinking "airfoil" on your next mechanical-draft installation, think of American Blower.

For, the advanced design of American Blower Airfoil Fans provides a smooth interworking of properly designed housing, streamline inlets, and wheel component parts – which results in higher efficiency, lower power consumption. The nonoverloading horsepower characteristic makes it possible to select a driving motor close to the fan horsepower.

Team this fan with American Blower *Gyrol*® Fluid Drive and you have a unit which gives high efficiency with low operating cost – plus quieter operation over the full operating range, and longer life of the critical fan parts. In addition, a motor with standard WR^2 capacity is all that is required, because of low starting inertia.

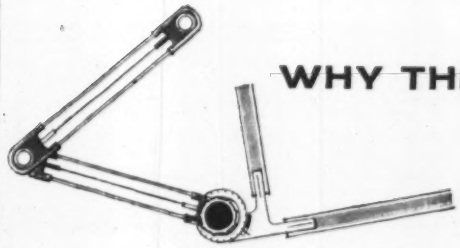
Why not talk to an American Blower sales engineer about *your* requirements. His knowledge of air-handling equipment can prove invaluable to you. Call our nearest branch office, or write: American-Standard,* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

*American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

American-Standard Products

AMERICAN-Standard

AMERICAN BLOWER DIVISION



WHY THINGS RUN SMOOTHER WHEN YOU SPECIFY HYATTS

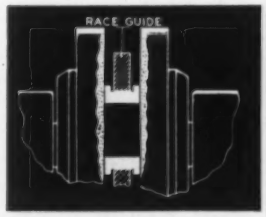
SCRUPULOUS CONTROL OF FINISHING OPERATIONS ASSURES SUPERIOR INNER RACES

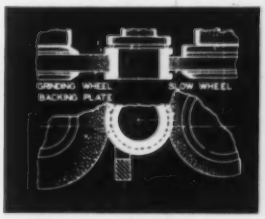
The function of a bearing inner race is to provide a fatigue-resistant surface between shaft and rollers. Because of the smaller area of contact between inner race and rollers, as opposed to outer race and rollers, there is a heavier load on the inner race.

Because of this concentrated load, *the inner race is the critical member of any roller bearing*, from the fatigue life standpoint.

To assure the finest possible inner races, and therefore smoother, longer performance, HYATT exercises scrupulous control over the four critical finishing operations detailed at the right. It's another good reason why so many designers prefer HYATTS.

You will find full selection and application data in HYATT Catalog 150, or call your nearest HYATT Sales Engineer.
Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey, Pittsburgh, Detroit, Chicago and Oakland, California.



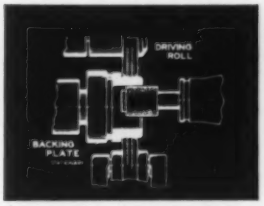


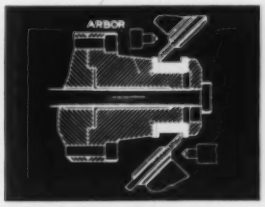
1 DOUBLE END GRIND

Grinding sequence is important. Ends are first faced off *square and parallel* to serve as accurate reference during later work. Hyatt double end grind provides excellent control of parallelism.

2 CENTERLESS PATHWAY GRIND

This Hyatt-pioneered process holds taper and out-of-round to minimum, produces as nearly perfect cylinder as commercially practical. Backing plate against ground end insures accuracy.



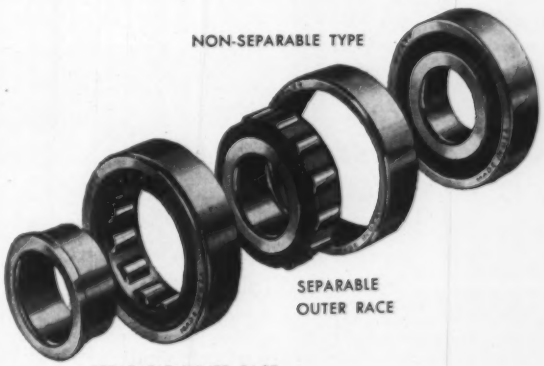


3 CHUCKLESS BORE GRIND

Here again, the centerless process assures a bore concentric with pathway, with minimum wall variation, by removing stock from high spots passing between drive roll and grinding wheel.

4 FLANGE GRINDING

To assure that they will run true with roller pathway, all flange faces are also ground using squared ends for reference. This provides vital even contact with ends of rollers.



THE RECOGNIZED LEADER IN CYLINDRICAL BEARINGS

1908–1958 GM FORWARD FROM FIFTY

HYATT HY-ROLL BEARINGS FOR MODERN INDUSTRY

ABOUT MEN AND WEAPONS

For centuries men have tried to develop new and more powerful weapons to achieve victory in war.

Lately these have been weapons of unprecedented power.

Now war can become race suicide, and victory thus gained is a delusion.

Yet we keep on trying to develop new and more powerful weapons, because we must.

Not because we seek victory through a nuclear war, but because through strength we may prevent one.

For as long as there are powerful forces with a record of cynical duplicity and oppression, the free world must have weapons capable of neutralizing them.

At least until men learn that the only alternate to peace is oblivion.

At Sandia, we play an important part in providing this protective strength. Our scientists and engineers are responsible for research, design, and development of nuclear weapons for the Atomic Energy Commission. This makes these men exceptionally valuable assets in our nation's efforts to secure the future.

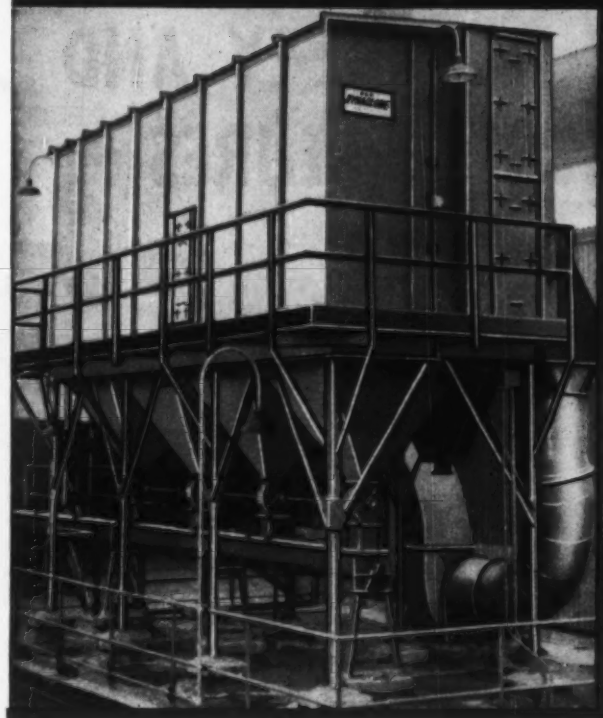
We need more such men — outstanding engineers and scientists in many fields, especially at the highest academic and experience levels. At Sandia in Albuquerque and at our branch laboratory in Livermore, California, we need their knowledge, skill, and perseverance.

If you can help us meet this need, or if you know anyone who can, write Staff Employment Section 553.

SANDIA CORPORATION

ALBUQUERQUE, NEW MEXICO

Now . . . a New High in Dust Filter Efficiency . . .



New SLY "ROLL-CLEAN" Dynaclone

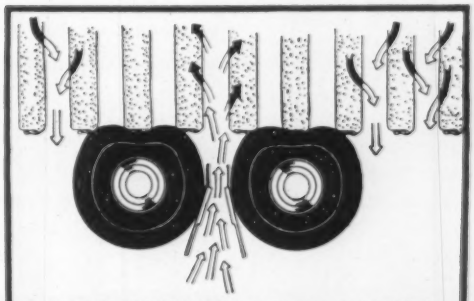
THESE NEW FIELD-PROVEN FEATURES

- Easier filter bag changing.
- Greater cloth area.
- Fewer operating parts.
- Free-rolling cleaner — no sliding.
- Complete dust seal — automatic seal adjustment.
- Easy access to all dust filter parts for inspection and servicing.

PLUS THESE TIME-TESTED DYNACLONE ADVANTAGES

- Constant suction at dust sources — complete dust collection.
- Self-cleaning for continuous operation.
- No auxiliary motors or blowers required for filter-bag cleaning.
- Greater filtering capacity and smaller space requirements — more cloth per cubic foot of filter than any other make.
- Lower power requirements.

The original self-cleaning dust filter, the Dynaclone has proven itself the most efficient dust filter ever made. The "Roll-Clean" Dynaclone combines design simplicity and rugged construction to insure even greater operating efficiency . . . even longer trouble-free service.



NEW "ROLLER CLEANER" provides greatly simplified method of cleaning dust from filter bags. Resilient rubber rolls automatically adjust to form a positive dust seal as each row of bags is cleaned by atmospheric air.

NEW CATALOG

36-page Bulletin 104 gives full details about "Roll-Clean" Dynaclone and other Sly Filters . . . contains valuable engineering information. Write for copy.

SINCE 1870 SLY

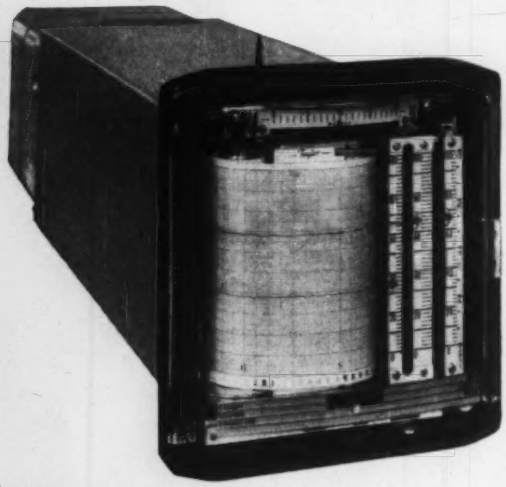
THE W. W. SLY MANUFACTURING CO.

4768 TRAIN AVENUE • CLEVELAND 1, OHIO

OFFICES IN PRINCIPAL CITIES

New Taylor TRANSCOPE Recorder brings you*

REVOLUTIONARY ACCURACY AND BIG-INSTRUMENT FEATURES



"No other recorder, regardless of size, puts so many features in so little panel space."

Front of Panel Control Settings let you make adjustments easier, quicker, and better . . . *from the front of the panel* . . . while recording! You can clearly see what you are doing, and the results, because the record is continuous.

Stays on Automatic Control while the recorder is removed for inspection. The unique Set Point Transmitter remains plugged in the case, providing continuous fully automatic control.

Complete Indicating Control Station while recorder is removed. You see the variable. There's no need to shut down the process for instrument service or adjustments. Horizontal gage at top of recorder will show either process variable or air output to valve, as desired.

Receives Three Variables to be recorded or indicated; has a Set Point Transmitter, an Automatic-to-Manual switching lever, a Cascade or process-output indicator, and many other features . . . all in a compact case.

"SERVOMATIC" Motor assures lifetime accuracy of pen position. Transmitter signal is received and amplified by individual force-balance servomechanisms. Spring feedback and powerful pneumatic motor give 150 times greater power than normally available for pen positioning.

0.1% Threshold Sensitivity—a new standard of accuracy. Responsiveness to transmitter output is 0.1%, and because of the very small pneumatic displacement of the input capsule, is practically instantaneous.

Optional Alarms. Each SERVOMATIC motor can operate either an electric or pneumatic alarm. Each alarm can be adjusted for one high and one low, or two high or two low operating points.

For further information about this revolutionary new recorder, see your Taylor Field Engineer, or write for **Form No. 98282.** Taylor Instrument Companies, Rochester 1, N. Y., or Toronto, Ontario.

*Trade-Mark

MADE FOR EACH OTHER!

The Taylor TRANSCOPE Controller and Recorder are companion instruments. Together they give you new standards of process control performance . . unprecedented accuracy and adaptability.

Ideal for the time constants of modern processing, exceptionally fast and responsive to adjustments, the TRANSCOPE Controller is also highly adaptable and simple to maintain. Write for **Bulletin 98278.**

Taylor Instruments

MEAN

ACCURACY FIRST

VISION · INGENUITY · DEPENDABILITY

Rust-Oleum is distinctive as your own fingerprint. Accept no substitute.

. . . goes on faster, stops rust, lasts longer over rust!

ONE MAN often does the work of two!

EASIER TO USE—because Rust-Oleum 769 Damp-Proof Red Primer goes over rusted metal after scraping and wirebrushing to remove rust scale and loose rust—usually eliminating costly surface preparations. *Stops Rust*—because Rust-Oleum's specially-processed fish oil vehicle *penetrates* rust to bare metal—driving out air and moisture that cause rust.

LASTS LONGER applied over rust—and teamed up with Rust-Oleum's many attractive finish coatings, assures lasting beauty. Try Rust-Oleum on *your* tanks, metal sash, machinery, wire fences, stacks, girders—or around *your* home. Prompt delivery from Industrial Distributor stocks. Write for illustrated literature with color charts showing colors and applications.

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RUST-OLEUM®

30% GREATER COVERAGE—MANY ATTRACTIVE COLORS

Rust-Oleum covers up to 30% more area, depending upon surface condition and porosity. And you can beautify as you protect with Rust-Oleum finish coatings in Aluminum, White, Red, Gray, Green, Blue, Yellow, Black, etc.

STOPS RUST!®

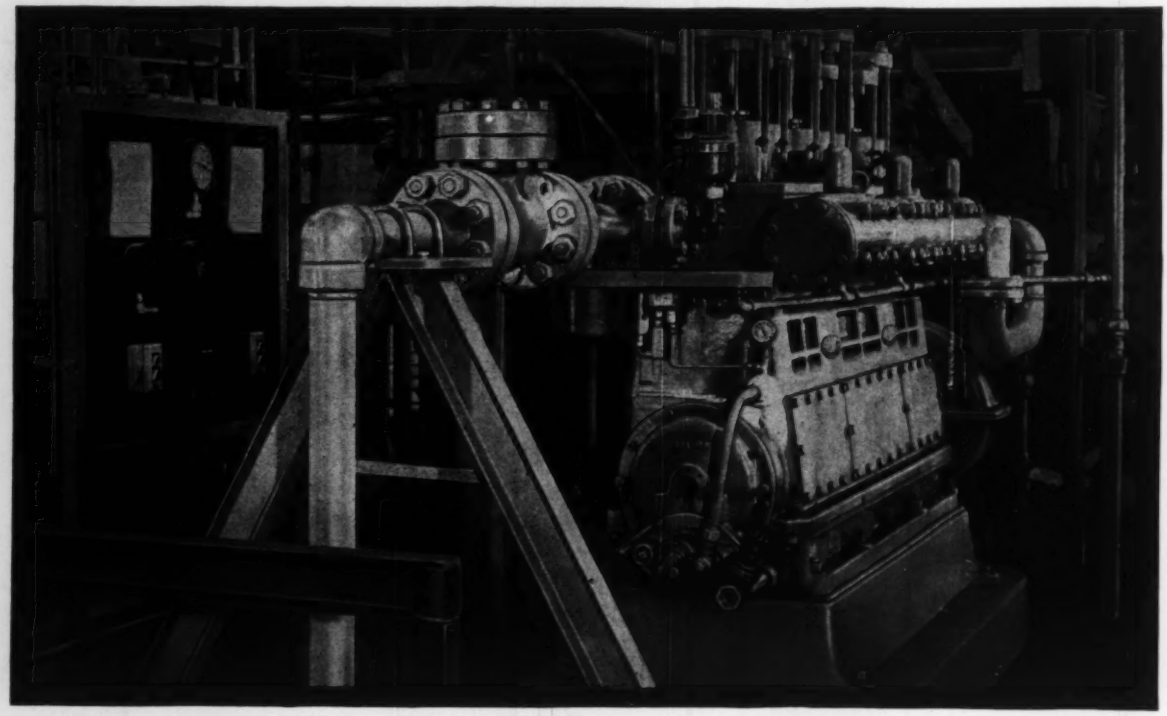
Rust-Oleum and Stops Rust are brand names and registered trademarks of the Rust-Oleum Corporation.

Write for special report showing Rust-Oleum penetration to bare metal.

MIDWESTERN DIE CASTER FINDS ANSWER:

How to pump hydraulic fluids non-stop when downtime means loss of production

During "rush seasons," when shifts work around the clock, this large midwestern manufacturer must have constant, dependable hydraulic power. One hundred percent capacity can only be maintained when the hydraulic system delivers a steady output pressure with no downtime.



How the problem was solved: Foreseeing 24 hour days, seven days a week, the die caster turned to Aldrich. As new facilities were added, so were Aldrich Pumps. The first, a 250 gpm pump, was installed four years ago. Since then, three more 207 gpm pumps have been added. All are 2¼" x 5", 1500 psi, gear driven Aldrich Septuplex Pumps, equipped with 200 hp motors.

Result: Just what you'd expect of an Aldrich Installation—steady dependability for continuous operation—highest reliability for intermittent service. Maintenance is held to a minimum. Operating efficiency has remained constantly high. Get full information on Aldrich Pumps and their advantages. Write the Aldrich Pump Company, 8 Pine St., Allentown, Pa.

the toughest pumping problems go to ALDRICH

An improved
Combination Starter
for extra safety

While the changes in the new Allen-Bradley Bulletin 712 and Bulletin 713 starters may be relatively minor, they were made in your interest—to give you the best control on the market.

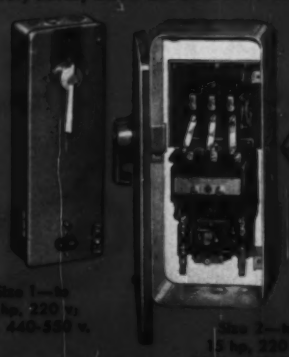
The new operating lever has been attractively restyled and structurally improved. Now the disconnect switch can be locked "open" or locked "closed"—with three padlocks of any kind. For the maintenance engineer, a concealed latch pin is built into the lever, which permits opening the door of the cabinet without opening the disconnect switch and stopping the motor. The door can also be padlocked shut independently of the operating lever.

With the disconnect lever in the "off" position, the cabinet door can be opened. At a glance, it can be seen that the movable contacts are open. An added "safety" feature—the incoming line connections are covered with an insulating plate to prevent accidental contact.

ALLEN-BRADLEY
QUALITY
MOTOR CONTROL

Allen-Bradley Co.
1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

BULLETIN 712—These modern A-B combination starters cost no more than a separate starter and disconnect switch, and make a neater, safer, more attractive installation.



Size 1—to 7½ hp, 220 v; 10 hp, 440-550 v.

Size 2—to 15 hp, 220 v; 25 hp, 440-550 v.

Size 3—to 30 hp, 220 v; 50 hp, 440-550 v.

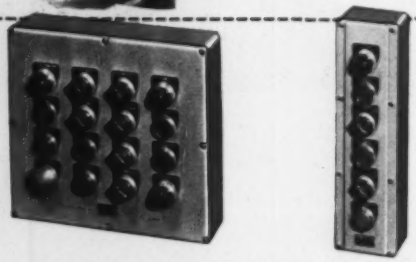
Size 4—to 50 hp, 220 v; 100 hp, 440-550 v.

Not only the Motor Starters, but the Accessories must be "Quality," too!

A-B QUALITY

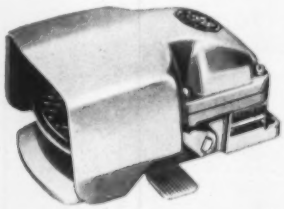
we specify ALLEN-BRADLEY ...all the way

"Trouble" that shows up in a motor starter is often traced to a faulty operating auxiliary—such as a limit switch or even a push button station. Allen-Bradley builds the same high quality into its many accessories as it does into its motor starters—to give you millions of trouble free operations. They are also tested as thoroughly. Contacts are usually double break and always are of a silver alloy, which means they remain in perfect operating condition. It will pay you, too, to specify Allen-Bradley *Quality* control—"all the way!"

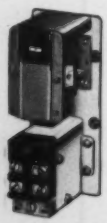


Bulletin 800T Oiltight Control Stations. Available in from one to sixteen units, in die cast aluminum enclosures.

Bulletin 802 Precision Limit Switch, with oil-tight head and body.

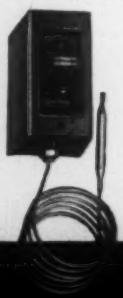


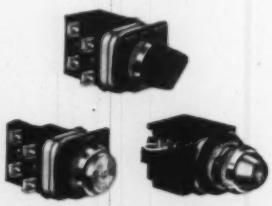
Bulletin 805 Foot Switch. In rugged die cast enclosure for the toughest service.



Bulletin 849 Pneumatic Timer. Reliable and accurate.

Bulletin 837 Temperature Control with snap action, precision switch.





Bulletin 800T Oiltight Push Button, Selector Switch, and Press-to-Test Pilot Light.

Bulletin 800 Standard Duty Push Button. One, two, and three buttons; also as selector switch.

Bulletin 836 Pressure Control in NEMA 4 watertight enclosure.

3-58-MR

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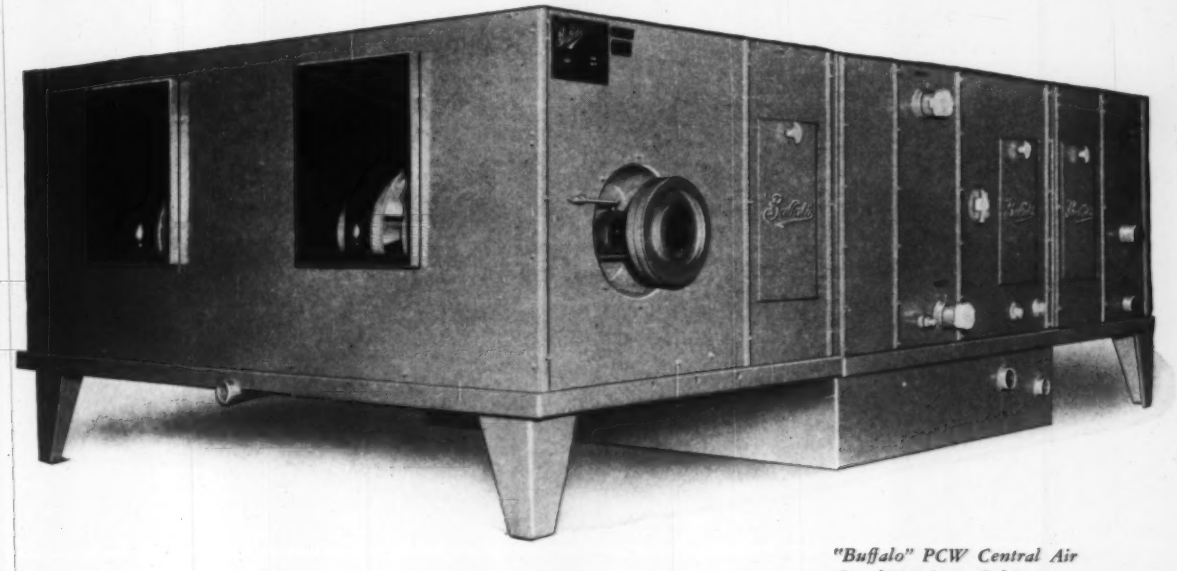
ALLEN-BRADLEY
QUALITY
MOTOR CONTROL



"Buffalo" PCW Central Air Conditioning Cabinet — complete facilities, including Washer section.

PERFORMANCE-PLUS for your CENTRAL-SYSTEM AIR CONDITIONING JOBS!

"Buffalo" Central Air Conditioning Cabinets are built to the same strict "Q" Factor* standards as "Buffalo" Fans — and are everywhere justifying this "extra" construction by completely satisfactory performance. "Buffalo" features include:

HEAVY-DUTY SECTIONALIZED CABINETS—rigid and strong for years of continuous service—properly insulated — interchangeable and demountable for simple installation and servicing, or later addition of sections.

QUIET, STABLE PERFORMING FANS—"Buffalo" mixed-flow fans on oversize hollow shaft, permitting as many as 4 fans in parallel supplying different systems efficiently and without pulsation. Stability over a wide operating range.

QUALITY AEROFIN COILS AND "BUFFALO" PUMPS — plus easily removable filters, outside lubrication, manual or automatic damper control — available in vertical or horizontal models. Write for Bulletin AC-120.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY
BUFFALO, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

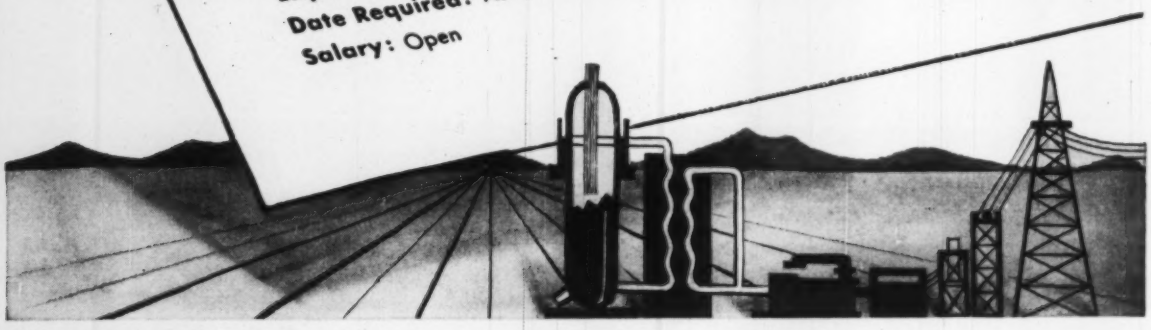
"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

better your future at BETTIS

MECH. ENGINEERS

To: Personnel Manager
From: Project Manager
Position: Mechanical Engineer with B.S. or M.S., to carry out theoretical and experimental investigations in heat transfer, plus analysis of both steady state and transient conditions—thermal and hydraulic test design—stress analysis—power plant and pressure vessel design.
Experience: 2-10 years
Date Required: As soon as possible
Salary: Open



At Bettis, you'll be a part of one of the leading companies in the field of nuclear power research and development. You will have the opportunity to work with some of the most widely recognized nuclear scientists in America. As Bettis continues to set the pace in the expanding nuclear power industry, you'll advance too in position and salary, toward a successful future.

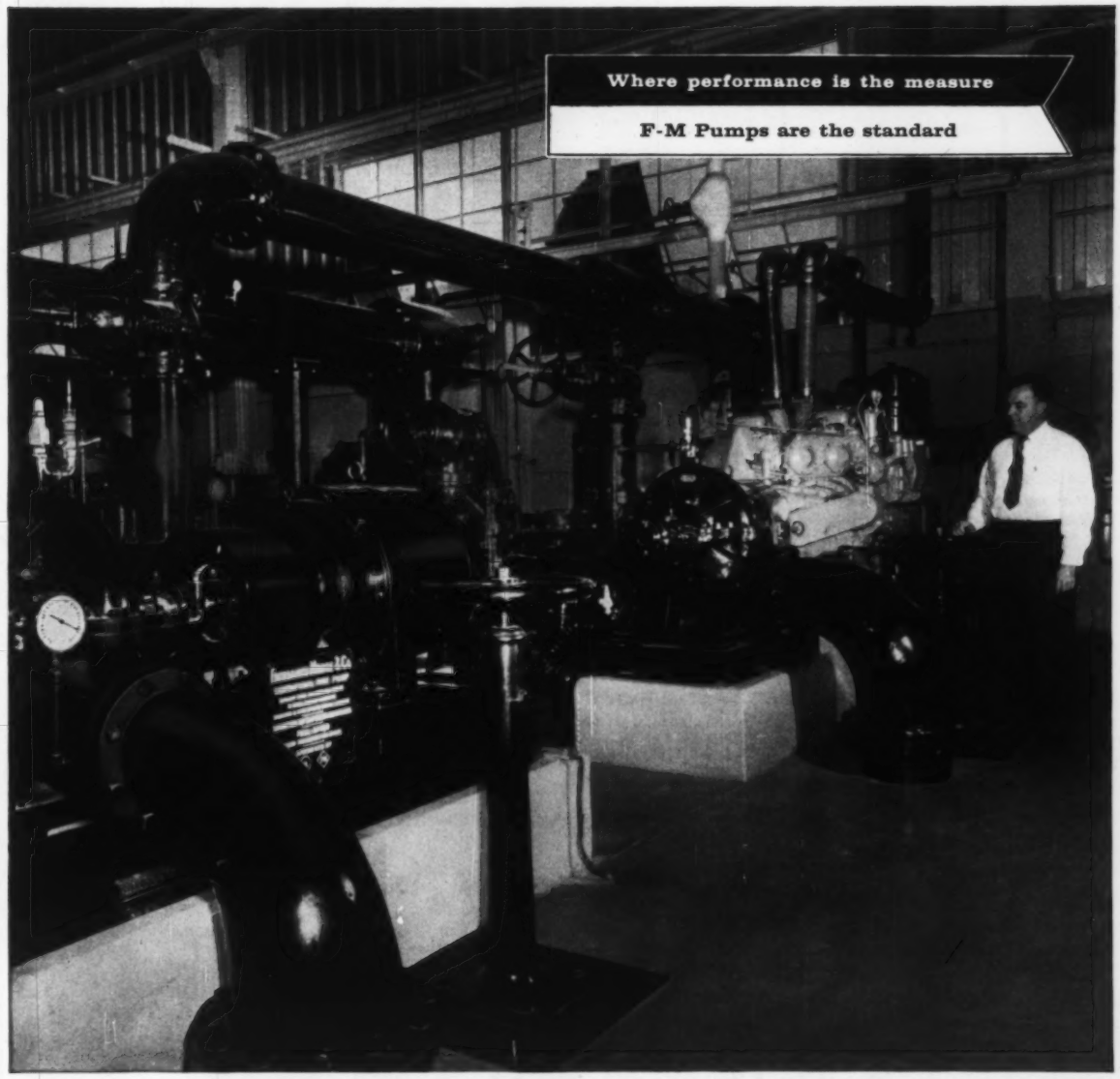
Bettis is located in South Hills, just twelve miles from Pittsburgh. This carefully chosen site provides for comfortable suburban living yet is convenient to the new metropolitan Pittsburgh with all of its educational, cultural and recreational facilities. Bettis also offers a variety of educational opportunities, including Doctoral and Fellowship programs for advanced study in the application of your specialty to the field of atomic energy.

If you feel you qualify for a career in nuclear power and you are a U. S. Citizen, write to Mr. M. J. Downey, Dept. #A-20 Bettis Atomic Power Division, Westinghouse Electric Corp., P.O. Box 1468, Pittsburgh 30, Pa.

BETTIS ATOMIC POWER DIVISION

Westinghouse

BETTER YOUR FUTURE AT BETTIS



Mr. George Biggar, plant engineer of Ford Motor Company assembly plant at Mahwah, N. J., checks Fairbanks-Morse fire pumps (1500 gpm. motor-driven pump in foreground, 2500 gpm. diesel-driven pump near Mr. Biggar).

Ford guards against fire at giant new plant

To protect one of the world's largest auto assembly plants against fire, Ford Motor Company depends on these two Fairbanks-Morse fire pumps. As the heart of an extensive system, the two F-M pumps provide defense in depth, one pump backstopping the other.

This installation is typical of the great care and planning by modern industry to prevent the catastrophe of fire. Call in your F-M Sales Engineer for expert assistance in pump specification. As builder of the world's greatest variety of hydraulic combinations, Fairbanks-Morse will provide the exact type, exact size pump you need for maximum dependability.

For information write Fairbanks, Morse & Co., Dept. ME-3, 600 S. Michigan Ave., Chicago 5, Ill.
Ask for F-M Fire Pump Bulletins 5814F (horizontal) and 6920F (vertical).

FAIRBANKS-MORSE
a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME-WATER SERVICE EQUIPMENT • MAGNETOS

Fluid Power news

NEW 2,000 psi LONG-LIFE STEEL CYLINDERS

New Oilgear "Quality-Line" 2,000 psi Cylinders—for your tough jobs

Double-Acting Cylinders Designed for Continuous, Dependable, Long-Life Service

✓ Check these "Quality-Line" Cylinder Features:

✓ Dependable, Leak-Free, Long-Life Service Assured
Oilgear Cylinders still operating efficiently after 20 or more years in heavy-duty steel mill operations, presses, machine tools—cause equipment builders and users alike to claim—"For the lowest cost per year—it's Oilgear!" This reputation for reliability is the result of craftsmanship in every phase of proven, "gimmick-free" design and production that only four decades of experience can produce.

✓ Two Ram Sizes Available For Each Cylinder Bore Size
Standard or large—ground and polished rams have threaded ends and multiple wrench flats. Large rams provide exceptional rigidity and high return speeds.
Optional: alloy or hardened steel rams; chrome plating; special ram ends.

✓ Rugged, Shock-Resisting, "Hot-Rolled," Bar Steel Heads
Accurately machined and gauged for concentricity with cylinder bore and ram. New design saves space. Extra-large machined passages and pipe-tap-ports reduce fluid velocities, turbulence, and pressure loss. Straight or special tapped ports available.

✓ Confined, Preloaded, Super-"O" Cylinder Seals
Insure permanently leak-free, static and pressure seals between cylinders and heads.

✓ Heavy-walled, Seamless Steel Cylinders Precision Bored, Honed, and Polished
Carefully gauged for roundness, straightness, size—minimizes friction, slip, and wear.

✓ Simplified, Rotatable Head Mountings
Split, alloy-steel keeper rings and steel flanges allow heads to be rotated to any degree for mounting . . . re-positioned, or removed for inspection independently.

✓ Short, Recessed, Steel Tie Bolts
Eliminate long, sagging tie bolts, axial compression load on cylinders, distortion, stretching, exposed threads and nuts . . . permit individual head removal.

✓ Pistons Accurately Machined Concentric With Ram

✓ Four Precision-Fitted, Automotive-type Piston Rings
Effective sealing, exceptionally long life under severe, high temperature service.

✓ Molded, "V"-Type, Preloaded Ram Packing
Positive sealing action with uniform low friction characteristics. Face-mounted gland prevents excessive tightening and binding on ram.

✓ Large Area, Bushing Bronze Ram Guide

✓ Molded, Non-abrasive, Unit-Seal Ram Wiper
Has low friction coefficient—effectively removes dirt or abrasive material to prevent scoring ram, packing and guide wear, or infiltration into system. Maintains a sharp edge to uniformily clean the ram on every cycle.

✓ Exclusive, Self-Aligning, Adjustable Hydraulic Cushions
Available in front, rear, or both heads to eliminate shock, piston scoring, rapid wear, and check valves . . . an exclusive Oilgear design.

✓ Custom Application-Engineering Service
Given specific information, Oilgear Application-Engineers can recommend the best cylinder for your application. Oilgear will also custom-design and produce cylinders and complete Fluid Power Systems to exactly match your Controlled Motion requirements.

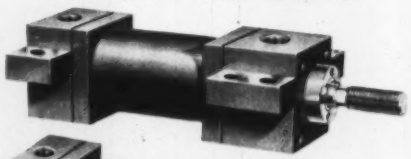
Call your local factory-trained, Oilgear Application-Engineer. Or write, giving specific information directly to

THE OILGEAR COMPANY
Application-Engineered Fluid Power Systems
1570 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

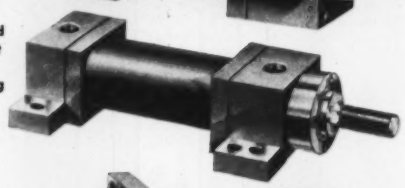
STANDARD MOUNTINGS

Heads can be combined, interchanged—rotated or removed independently.

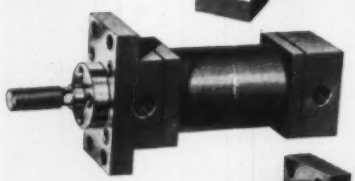
Front and rear Center Lug Mounting



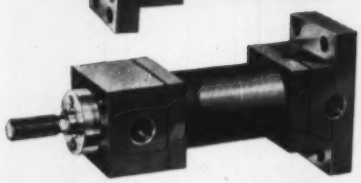
Front and rear Foot Lug Mounting



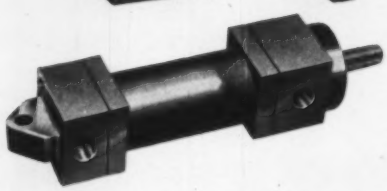
Front Flange Head Mounting



Rear Flange Head Mounting



Clevis Mounting and Plain Front Head



SIZES

Bore Diameter (i.d.)		2"	2½"	3¼"	4"	5"	6"	7"	8"
Standard Ram	Ram Diam.	1"	1"	1¼"	1½"	2"	2½"	2¾"	3"
	Max. Stroke	55"	60"	60"	65"	85"	95"	105"	110"
Large Ram	Ram Diam.	1½"	1¾"	2¼"	2¾"	3½"	4¼"	5"	5½"
	Max. Stroke	80"	87"	95"	105"	125"	140"	155"	160"

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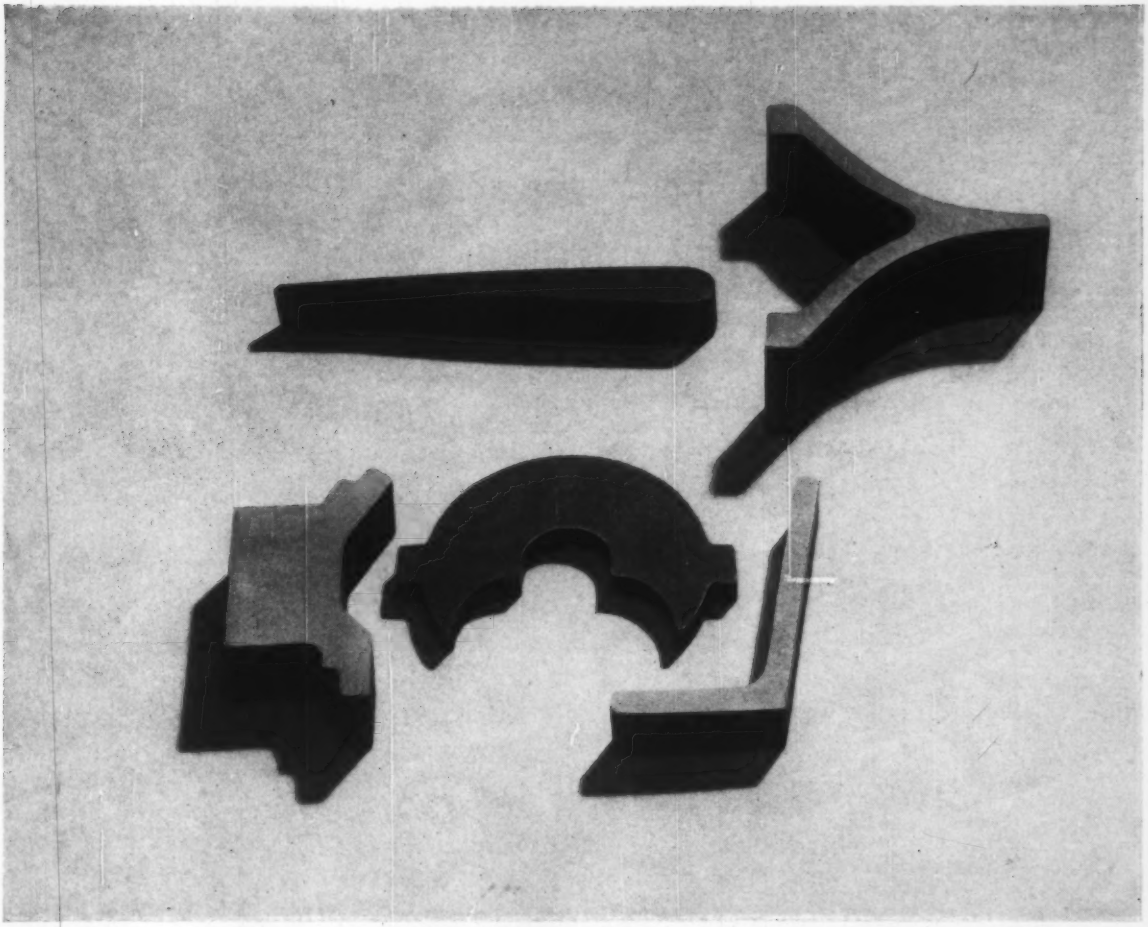

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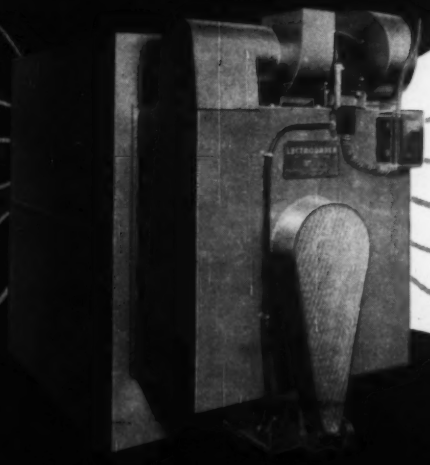

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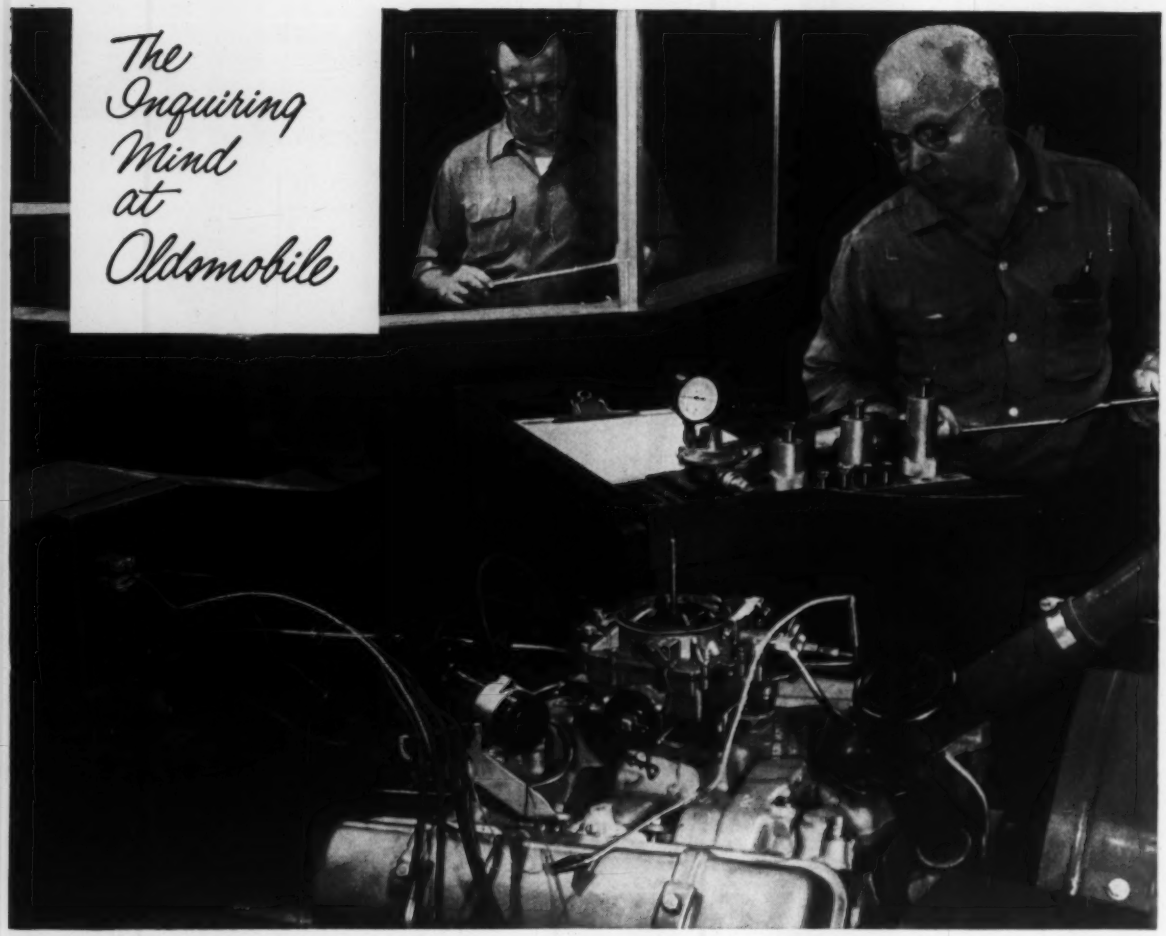

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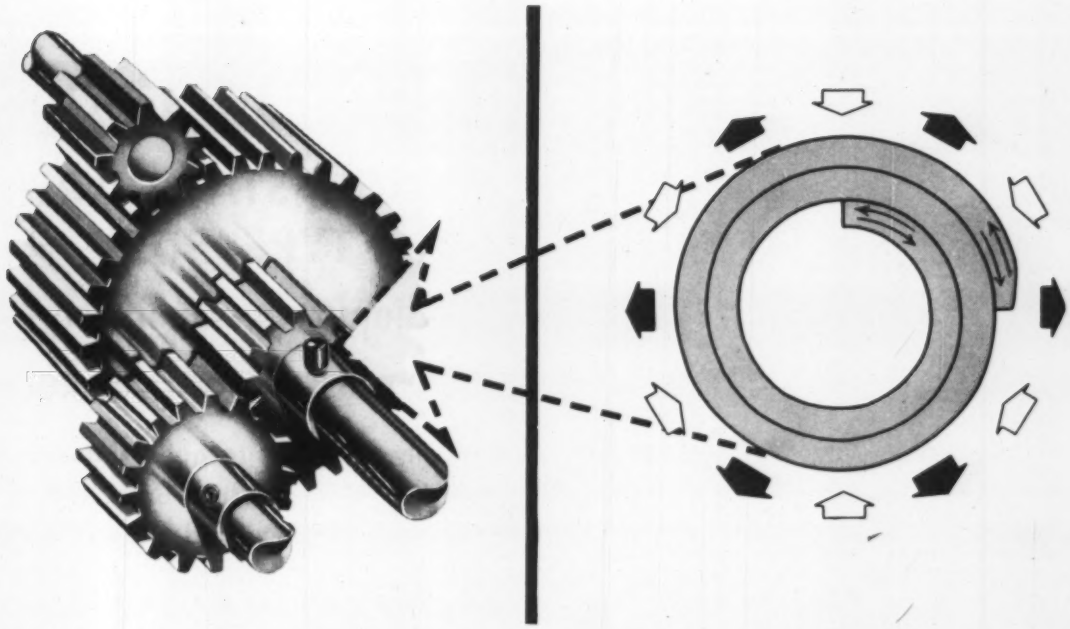

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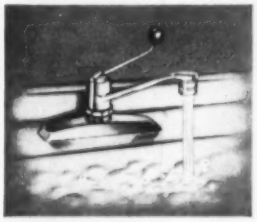
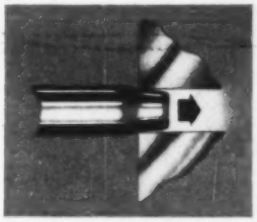
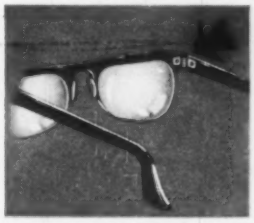
SPIROL gives these unique advantages



Non-heat-treated metals — such as low-cost brass, copper, nickel stainless steel — can be used in SPIROL true spring pins. Less resilient metals flex without failure, because there is no concentration of stress.



Wider hole tolerances eliminate reaming, reduce drilling rejects, cut production costs. Both plus *and* minus tolerances are allowed because of SPIROL spring pin's greater flexibility in expansion and compression.



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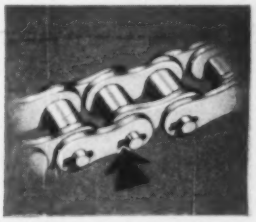

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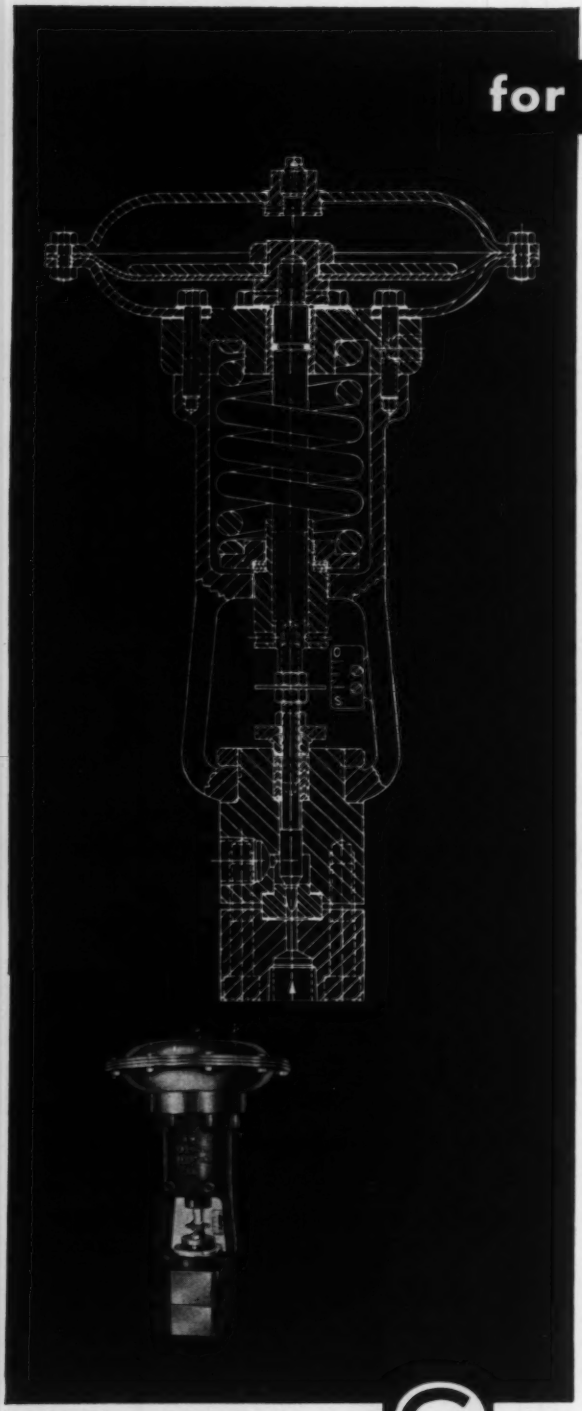

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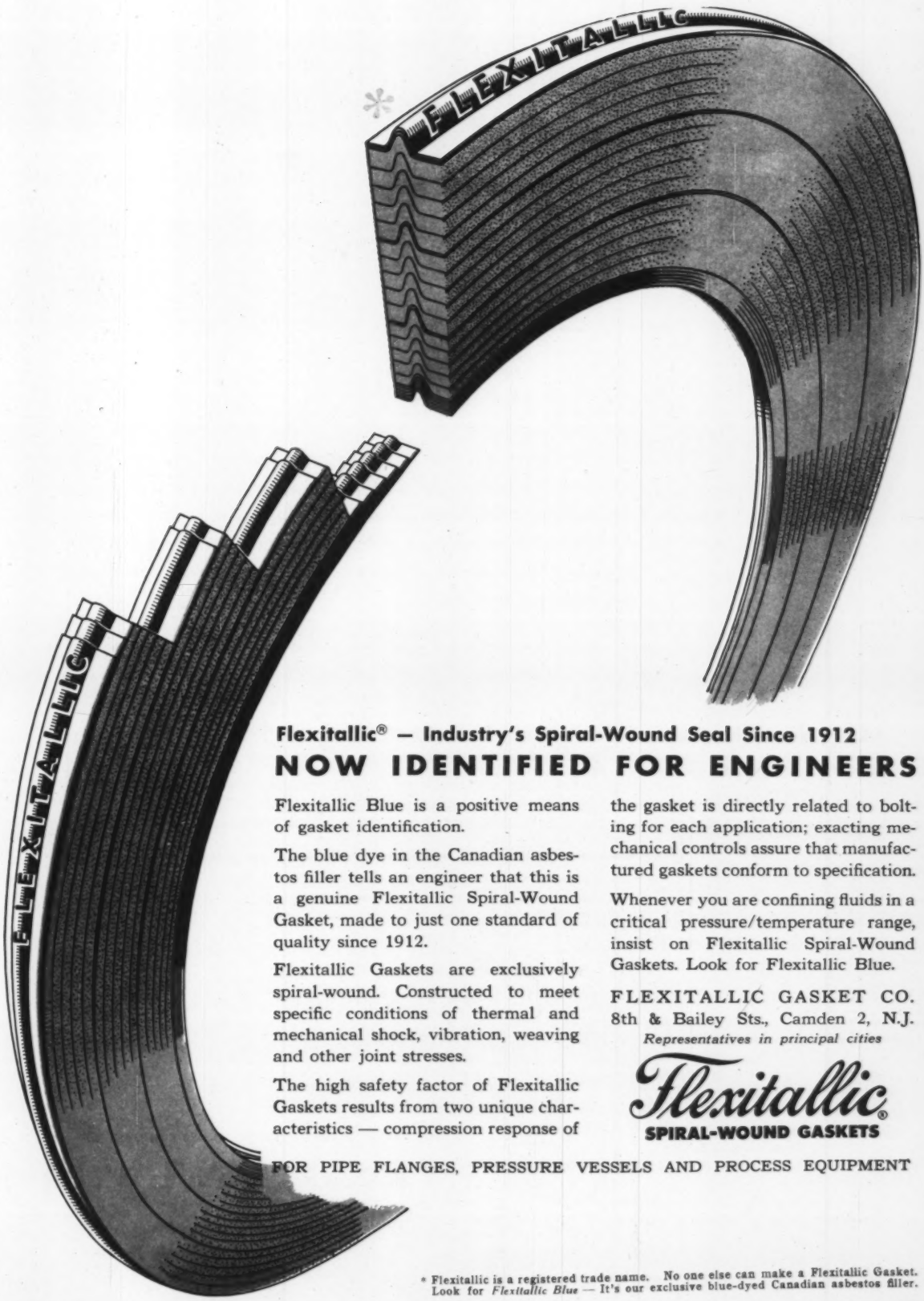

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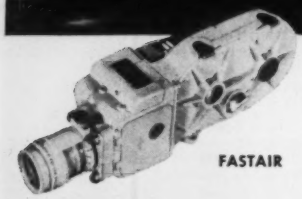

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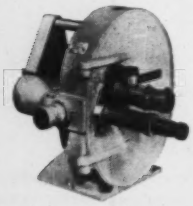

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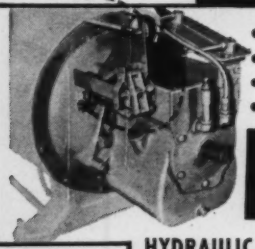

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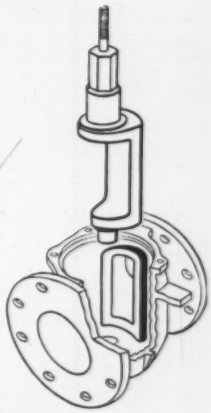

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February, 1958 CARD INDEX Vol. 80, No. 2

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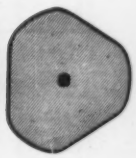

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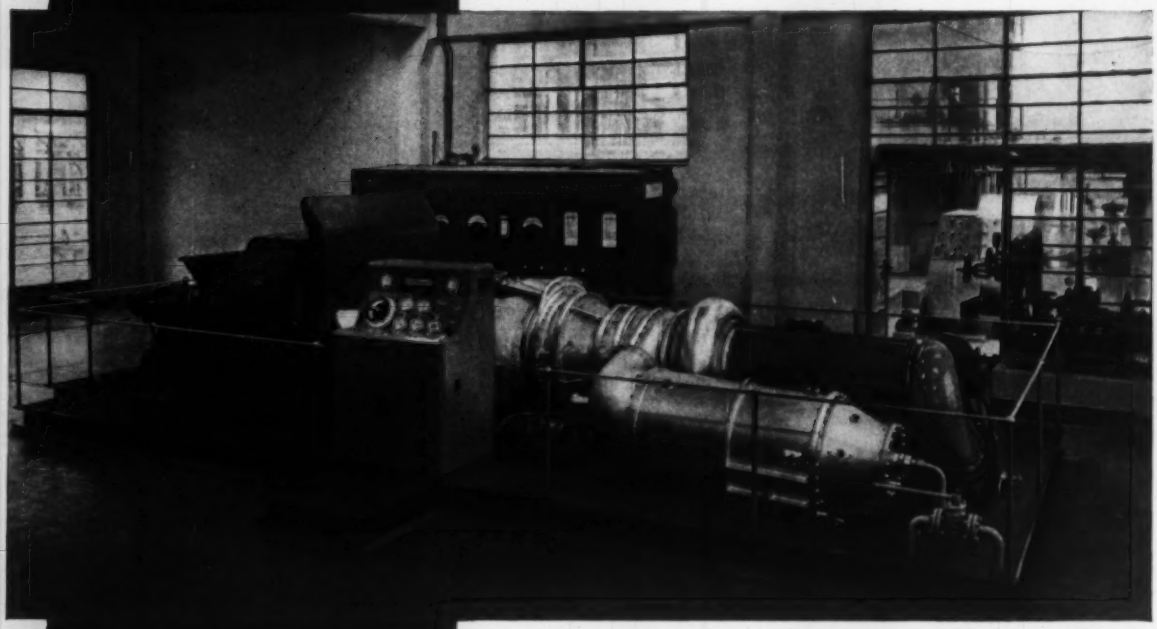

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The rapidly expanding, multi-plant, international CHEMSTRAND CORPORATION, already a leader in the synthetic fiber industry after only six years of operation, is seeking:

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A medium size company located in California is looking for a Hydraulics Engineer to take charge of their servo components in areas of research, design and development. Should have at least B.S.M.E. degree or equivalent. Must have experience in aircraft and missile hydraulics with emphasis on the design of hydraulic servo components plus knowledge of related manufacturing processes. Experience in the design of electrohydraulic servo valves, desirable. Will consider a senior engineer ready to assume greater responsibility. State in first letter: Age, education, training, positions held and earnings. All replies will be held in strictest confidence.

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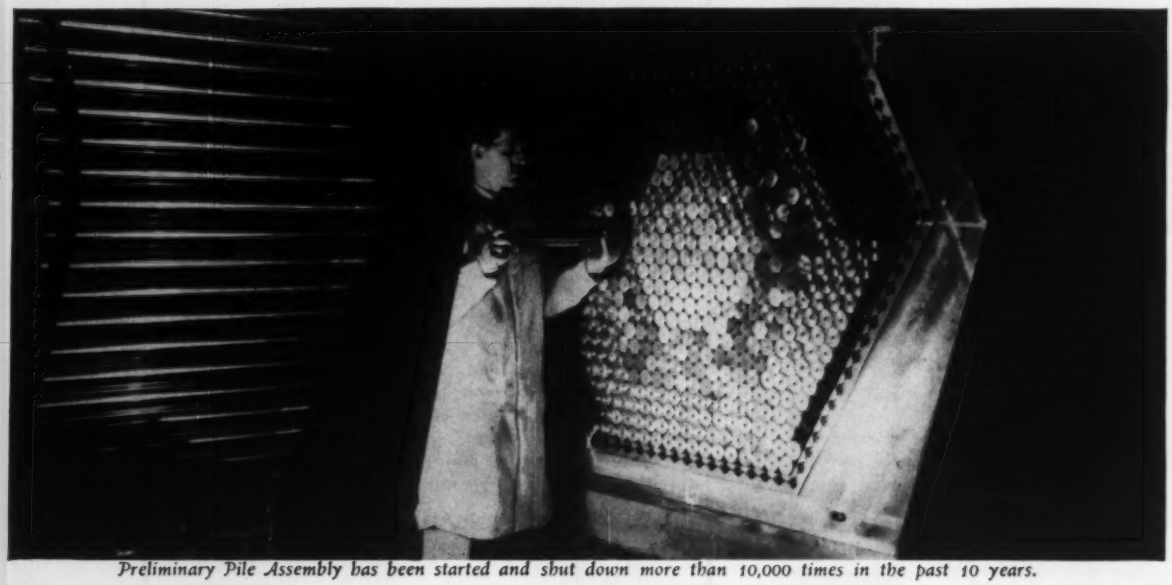
furthering creative technology at

The KNOLLS ATOMIC POWER LABORATORY

To men concerned with pushing back the frontiers of reactor technology, the many facilities for fundamental and applied research at KAPL hold a special interest. Among the unique critical assemblies for experimental purposes is the PPA, *pictured below.* This Preliminary Pile Assembly can be shut down and restarted in 15 minutes in order to rearrange fuel elements to simulate different reactor designs. Only last year two new buildings were completed to house two additional experimental reactors, a 704 computer, and to provide modern office facilities for an enlarged mathematical staff.



Preliminary Pile Assembly has been started and shut down more than 10,000 times in the past 10 years.

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Engineers and Scientists
from
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where expanding
missile programs insure more
promising careers

This huge new shock tube—performing basic research and providing ballistic missile design data at speeds up to 20,000 feet per second is now in operation at the division's research and development laboratories. The 44-foot long tube is used for advanced design work on the Polaris solid fuel ballistic missile. Temperatures and pressures generated within the tube simulate those encountered by a long-range ballistic missile as it plunges from space into the earth's dense blanket of air.

In addition, Lockheed scientists are now using magnetically driven gas shock tubes to produce samples of gas at temperatures over 100,000 degrees centigrade and moving at speeds in excess of 30,000 feet per second.

The growing importance of missiles' role in U.S. defense means our own varied missile activities will continue to expand. That is why engineers and scientists look to Lockheed Missile Systems for better opportunities to move ahead in their careers.

Openings exist now in our multi-million dollar research and development laboratories near Stanford University and less than an hour's drive from San Francisco. Such positions call for high levels of achievement in **Gas Dynamics, Structures, Ionic Physics, Materials Research, Aerodynamics, Thermodynamics, Solid State Electronics, Propulsion, Guidance, Flight Controls.**

Qualified engineers and scientists are invited to address inquiries to M. W. Peterson, Research and Development Staff, Palo Alto 24, California

Lockheed **MISSILE SYSTEMS**

A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

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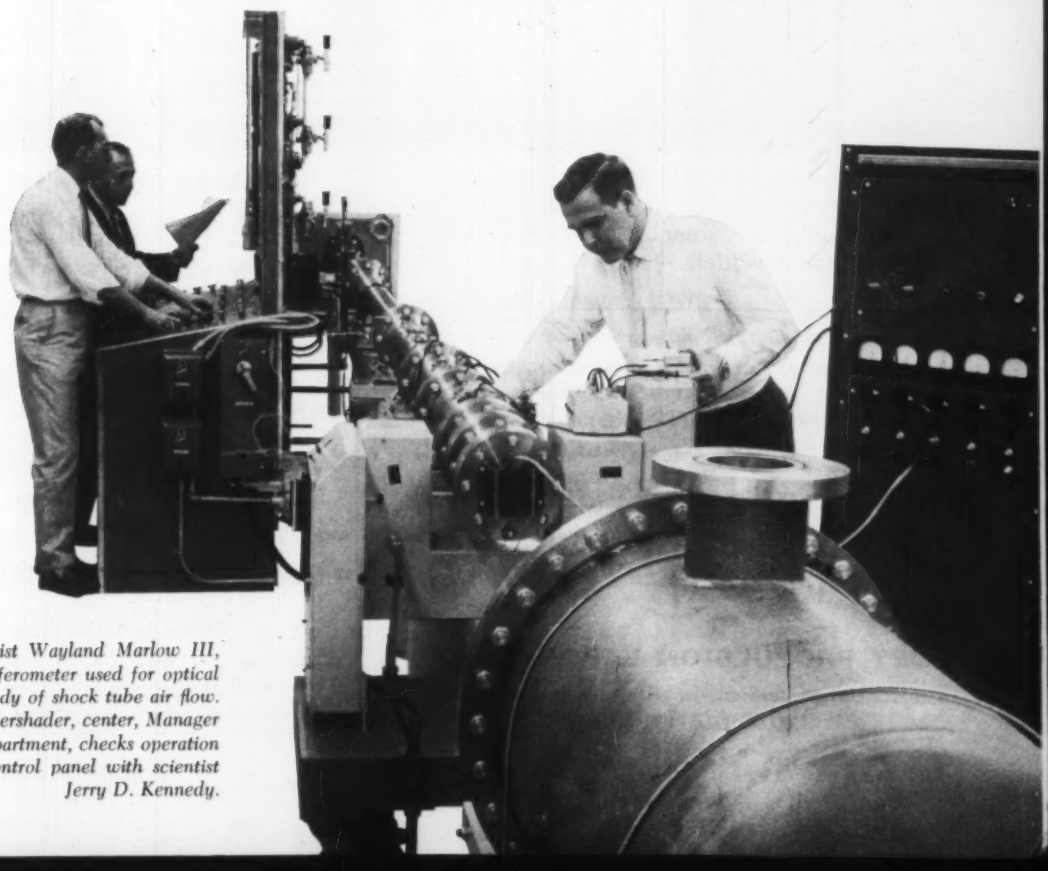
NEW SHOCK TUBE TESTS MISSILE DESIGNS FOR POLARIS



Scientist Wayland Marlow III, right, adjusts an interferometer used for optical study of shock tube air flow. Dr. Daniel Bershader, center, Manager Gas Dynamics Department, checks operation at the control panel with scientist Jerry D. Kennedy.

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A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

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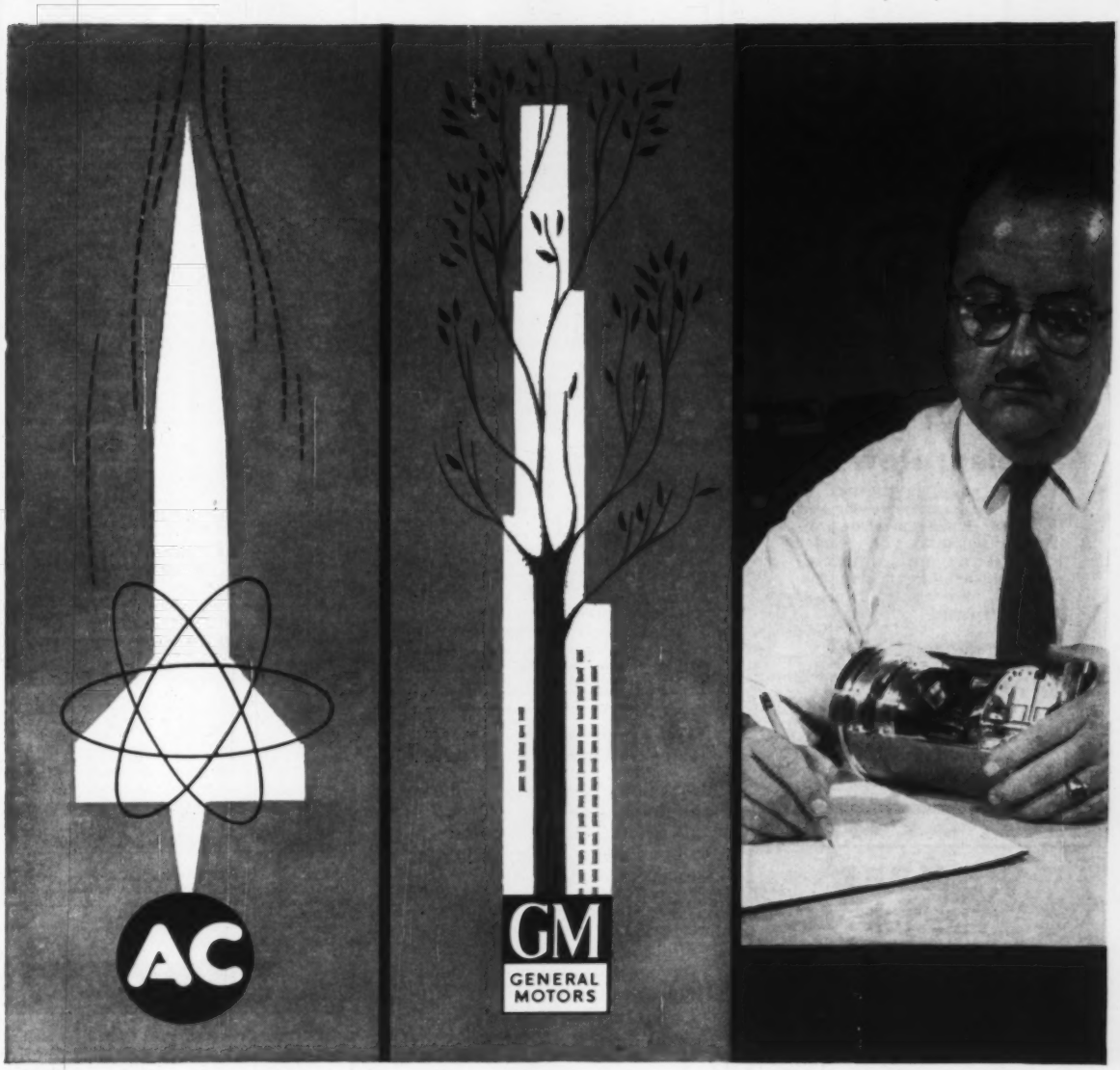

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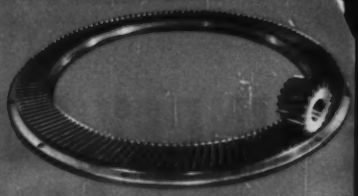

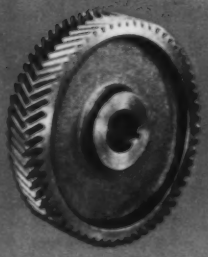

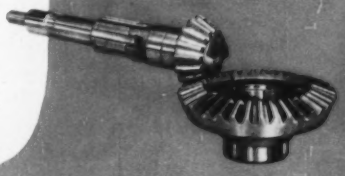

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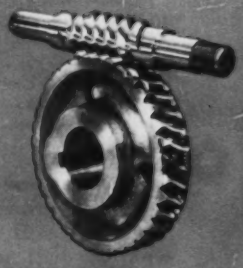

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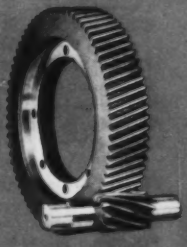

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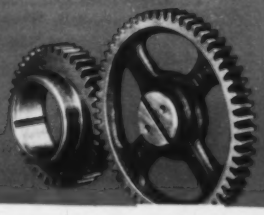

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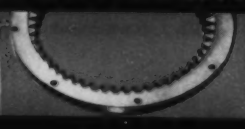

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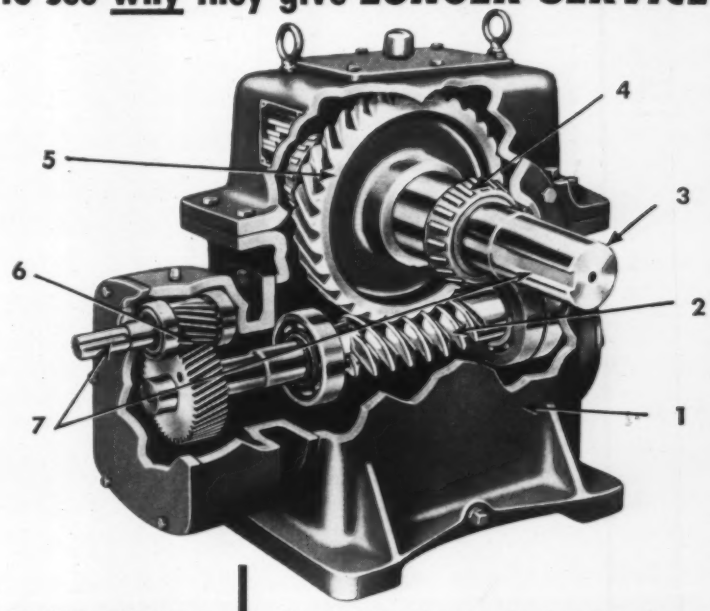

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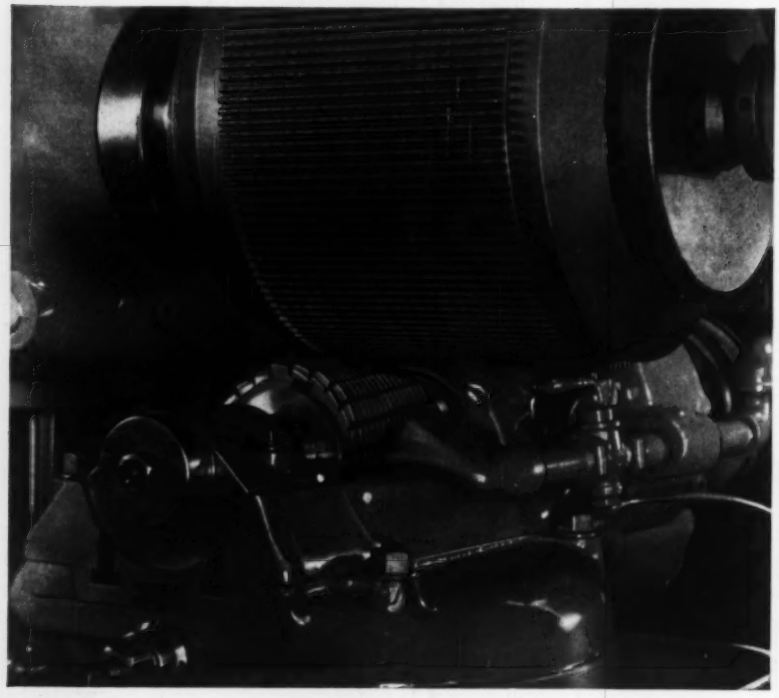

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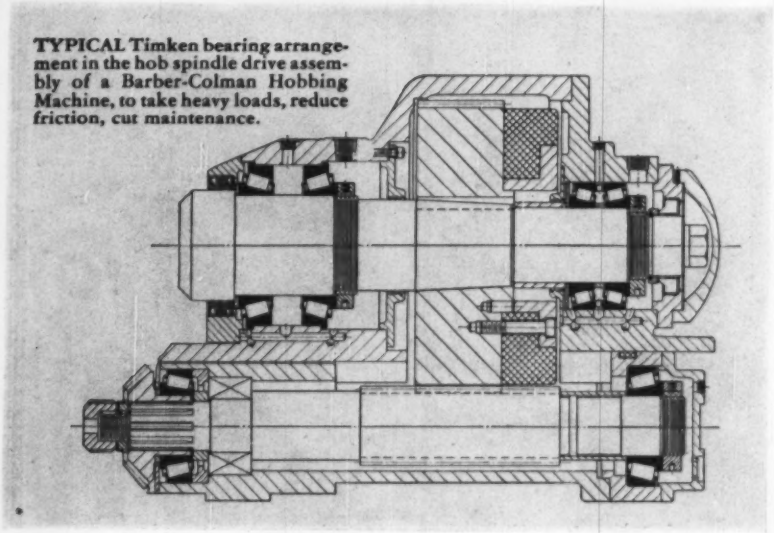

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